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MAJOR-GENERAL SIR PERCY ZACHARIAH COX,

G.C.M.G., G.C.I.E., K.C.S.I.

PRESIDENT 1933–36

THE sudden death of Sir Percy Cox on 20 February 1937 while hunting with the Oakley Foxhounds brought to an end a career of unusual distinction and brilliance, made in the torrid climate of the Persian Gulf, and in Arabia, Persia, and 'Iraq. Naturally modest and self-effacing, his reputation in the councils of the great Badawi tribes of Arabia, of the shaikhs of the Persian Gulf coast, and of the political leaders in 'Iraq was greater than that ever reached by any other British officer. It was earned unostentatiously by the inspiration of high example and a sympathy that enabled him to see the other man's point of view, combined with a strong personality, a dignified bearing, and an honesty of purpose that was never doubted.

Sir Percy Cox was the son of A. Z. Cox of Harwood Hall, Essex. Born in 1864, he was educated at Harrow and passed into Sandhurst in 1882; he served with 2nd Battalion the Cameronians from 1884 to 1889, when he joined the Indian Staff Corps, entering the Indian Political Department in 1890. In the previous year he had married Belle, daughter of Surgeon-General J. Butler Hamilton, R.A.M.C.

In 1893 Captain Cox was appointed Vice-Consul at Zeila, a lonely post where the desert of British Somaliland meets the sea. A harbour, that shallow Arab dhows alone can enter, and a custom house deal with a small caravan trade with the interior. A Political Officer's bungalow and a few huts were the sole buildings, and there were no trees to relieve the monotony. Here the young Political Officer and his wife might well have been depressed by the absence of amenities, but they welcomed the opportunity of occupying their leisure moments by starting what were to become valuable collections of sea shells and of postage stamps, and they often spoke of their time there as two very happy years. He was then transferred to Berbera, and in 1899 began his long connection with the Persian Gulf as Consul at Muscat. The climate of this picturesque but sultry port was even worse than that of Zeila, for the sun-baked rocks with which the town is enclosed absorb heat during the day

and radiate it at night, so that in those days sleep was often possible only by lying in sheets soaked in water. These conditions failed to sap his energy, and the skilful way in which he handled the intricate problems connected with Muscat brought him rapid promotion. During his five years as Consul, Cox made some short but important journeys into the almost unknown interior of Oman, mapping his routes and fixing his positions with G.M.T. read from a ship's chronometer carried on poles; and one outstanding journey across the Musandam peninsula which he described many years later to the Society in April 1925 (*Geogr. J.* 66 (1925) 192–227).

While at Muscat he first heard the call of the great South Desert of Arabia, and although he himself was destined only to see it from afar, it was through his influence, inspiration, and assistance that its eventual conquest was accomplished. The fauna of Oman is of special interest as it shows an affinity with the Indian rather than the Arabian group, and Cox, who was a first-class field naturalist, made there a collection of bird skins which he sent to the British Museum.

In 1904 he was promoted to Bushire as Consul-General, where his outstanding ability and grasp of affairs attracted the notice of Lord Curzon during his tour of the Persian Gulf. In him the Viceroy saw a man whose clearness of vision and accuracy in the smallest detail, combined with a strong but unassuming personality, would make an ideal British representative in the Gulf, and in 1909 he was gazetted its Resident. At this time Germany's intensive campaign for peaceful penetration was at its height. Plans were afoot for establishing the terminus of the Baghdad railway at the head of the Gulf in the territory of the Shaikh of Kuweit, and it was hoped by support of the Turkish occupation of Hufuf in the territory of Ibn Saud, by encouraging his rival Ibn Rashid, and by gaining control of the pearl fisheries, to make German influence paramount in the Gulf. These and similar activities, which were in the able hands of the redoubtable Herr Wassmuss, the German Consul at Bushire, were tactfully defeated by the British Resident. He not only strengthened the British position by new treaties, but under his firm influence the Gulf abandoned the remnants of its old infamies, gun running, slave dealing, and piracy.

In 1914 Sir Percy Cox, who had been created K.C.I.E. in 1911, was appointed Secretary (Foreign Department) to the Government of India and departed for Simla; but his residence in India was of short duration for on the outbreak of the Great War he returned to the Gulf as Chief Political Officer to the Indian Expeditionary Force D, and sailed with the advance brigade which anchored off Bahrein on 23 October 1914 and landed at Fao on November 6. He established his headquarters at Basra after it was occupied, until in the Spring of 1917 he moved up to Baghdad with General Maude. They were strenuous days in Basra as the tide of war flowed and ebbed. The offices of the Chief Political Officer were in a small mud-walled Arab house surrounded by date palms near Ashar Creek. Here he worked long hours while the thermometer registered temperatures of 120° F. and higher. His staff was small, but he was ably assisted by the Deputy C.P.O. Captain A. T. Wilson (now Sir Arnold Wilson, M.P.), a man with a thorough knowledge of the country and who, like his chief, had an amazing capacity for work. Sir Percy's

military training enabled the military and political machines to work in perfect harmony.

The foundation of a Civil Administration was taken in hand at once. The skeleton of the old but corrupt Turkish regime was retained, for in spite of all its faults of omission and commission, it was a system that the population understood. In a short time however it had been improved beyond recognition, and a brilliant body of British officers was trained and placed in charge of the political divisions. Tribal matters were dealt with in accordance with tribal customs and a more sympathetic attitude was adopted towards the various races, religions, and factions that comprise the people of 'Iraq.

The tribal shaikhs found in "Cokkus," as they called him, a leader and counsellor after their own heart, and the influence which he extended throughout Arabia has never been equalled. An Indian cavalry officer who served during the Mesopotamian campaign in the Royal Flying Corps, relates that in 1916 when the Corps was equipped with old-fashioned machines, and forced landings were to be expected, pilots and observers were issued with a linen document which was to be sewn inside the tunic or shirt. On one side was a map and on the other instructions in the event of forced landing and capture: some Arabic sentences, and the order to the prisoners to go straight up to their Arab captors, to hold on to their garments, placing themselves under their protection, and to say that they were friends of "Cokkus Sahib."

In 1918 just after the Armistice he handed over his office as Civil Commissioner in Baghdad to Colonel A. T. Wilson, and taking over an even more exacting post went to Tehran as H.M. Minister to Persia. Here a position of much perplexity had arisen owing to the exigencies of war. Military operations were taking place in Persia, a neutral country, and clashes between the views of officers commanding troops and of the Legation had been continual. By skilful handling Sir Percy Cox was able to bring about harmonious relations. The Anglo-Persian Agreement was negotiated by him under Lord Curzon's directions. Its aims were the strengthening and reform of the government of Persia with British military and economic advisers. It failed, partly because the Persians suspected that their independence would be jeopardized, and partly because it came at the very time when the rapid evacuation of British troops from Persia on demobilization led the Persians to believe that support in time of need would not be forthcoming.

Sir Percy had hardly time to settle down in Tehran when he was recalled to England and was entrusted with the greatest task of a life already filled with high achievement. It was suggested that an independent Arab state should be established in 'Iraq under a mandate from the League of Nations, the foundation being laid by the formation of a Council of State with State Departments under Arab Ministers, and with British officials as advisers under a British High Commissioner. The policy envisaged the enthronement of a king to be proclaimed by the free choice of the people of all denominations, races, and creeds, and the eventual termination of the mandate when the young 'Iraq nation was deemed to be fitted to stand alone. This was an experiment that had no precedent; and with the heterogeneous collection of races in 'Iraq, not only of Arabs belonging to the Sunni and Shia factions of Islam, but of minorities including Jews and Kurds, with Armenians and

other Christian peoples, the task of welding them into a unit under one sovereign might have appalled the stoutest of hearts. Cox was the only man who could be entrusted with the mission with any chance of success, and although he did not conceal his reluctance to accept the responsibility of initiating a policy which aimed at an early termination of the mandate, he returned to Baghdad in 1920 at the earnest request of His Majesty's Government.

By 1921, with the assistance of the aged Naquib of Baghdad as head of the Council of State, the stage was set for the choice of the sovereign. Among several aspirants the Amir Faisal, son of the royal house of Hejaz, was mentioned and he was invited to Baghdad as a guest of the 'Iraq Government. His dignified bearing and courtly speech won the hearts of Mohammedan, Christian, and Jew; his tour in the districts which was intended as a visit became a royal procession, and he was proclaimed king in the deserts and in the mountains of Kurdistan as well as in the towns of the two rivers. On his return King Faisal was enthroned in Baghdad by Sir Percy in August 1921 and in the subsequent years of his successful reign fully justified the trust that had been placed in his statesmanship. He acknowledged without reserve the debt that he and the young kingdom owed to the creative genius of the High Commissioner. Cox, with his flare for judging character, had selected a brilliant staff to help him. Among them was Miss Gertrude Bell, who was appointed Oriental Secretary, a position for which her academic mind and training and her unequalled knowledge of Arabian affairs and the feuds and allegiances of the desert tribes fully qualified her. Her rôle was to give interviews to the unending stream of visitors who desired to lay their views in person before the High Commissioner; a short précis of the business was then sent up with the caller to Sir Percy Cox. These reports were often literary masterpieces. The High Commissioner almost without exception saw everyone that came and interviews often occupied all the morning, which necessitated long hours in the office in the afternoon and evening to keep the rest of the work in hand. On one occasion the *ferash* or messenger came soon after dawn to sweep out the office and was startled to find Cox writing at his desk in his evening clothes; beside him was a high stack of finished and docketed files at which he had been working all the night; and within two hours he left the Baghdad aerodrome *en route* to Cairo by air.

Sir Percy Cox handed over the High Commissionership to Sir Henry Dobbs and left Baghdad in 1923. He lived for a short time in London, and in 1924 went to Constantinople as British Plenipotentiary for negotiations with Turkey regarding the Turco–'Iraq frontier. On his return he took a house in the village of Clapham near Bedford, spending his leisure in shooting, and hunting regularly with the Oakley Foxhounds. He was made a Deputy-Lieutenant for Bedfordshire. But his many interests in politics and science soon brought him back to London, although he retained his shooting and kept his hunters in Bedfordshire. On his retirement he was able to enjoy the meetings of the learned Societies, a recreation which owing to long service abroad had been hitherto denied him. He had been elected a Fellow of our Society in 1895 while serving as a Political Officer in Somaliland, and when in 1925 he was settled with his rich oriental collections in his Kensington home

he soon began to take a prominent part in the work of our Society in Kensington Gore. He was elected a Member of the Council in 1925 and served on it either as a Member or Vice-President till 1933, when he succeeded Admiral Sir William Goodenough as President for the usual three-year period. During this time he was diligent in the affairs of the Society, attending the Society's House almost every day and presiding at the meetings of Council and the various committees as well as at the evening meetings with unfailing regularity and great dignity. With his striking upright carriage and youthful figure he made a most impressive figure as President, and advanced the interests of the Society in every way. It must have been with the greatest satisfaction that he heard Bertram Thomas describe before the Society the first crossing of the Great South Desert of Arabia in 1931, for he had first known Thomas as one of his junior political officers in Basra; and Philby, whom he had first despatched as a novice in Arabian travel on a mission to His Highness Ibn Saud at Riyadh in 1917, and now a veteran of Arabian exploration, give his account of his great ride in 1932 from Hufuf to Wadi Dawasir.

He was elected a member of the British Ornithologists Union in 1922, joined the British Ornithologists Club, was a regular attendant at their meetings, and was made Vice-President in 1927.

It was his personal friendship with Ibn Saud that had enabled Cox to obtain permission for Major Cheesman to make his journeys to Salwa in 1921 and in 1923 to reach the oasis of Jabrin. During the Mesopotamian campaign and afterwards when he was High Commissioner Sir Percy Cox had made a valuable contribution to science by organizing the collection of specimens of the little-known fauna of 'Iraq and the Persian Gulf Islands which were presented to the British Museum. He also sent many rare and interesting animals and birds to the London Zoo, among them the Arabian ostrich—the first to be seen alive in England.

Throughout his official life Lady Cox accompanied her husband and endured with him his long service in stations where she was often the only white woman, and which owing to the high shade temperature and humidity are acknowledged to be the worst in the world. The welcome extended to ships of the Royal Navy on their visits to the Gulf ports, her work in Basra in the early days of the war when she undertook the distribution of war gifts to the troops, and her hospitality at the British Residency in Baghdad, will all be gratefully remembered. She was created a D.B.E. in 1923.

Sir Percy leaves a grandson, Derek, who is a Flight-Lieutenant in the Fleet Air Arm, his only son, who joined the Royal Flying Corps, having been killed during the Great War.

R. E. C.

A VOLCANO UNDER AN ICE-CAP. VATNAJÖKULL, ICELAND, 1934–36

NIELS NIELSEN

Evening Meeting of the Society, 8 February 1937

VOLCANISM in Iceland manifests itself in a variety of ways, and the course of the processes and their effects on the landscape are so rich in variation that no other place in the world provides so complete and comprehensive a representation of volcanic activity and the phenomena associated with it.

The course and result of volcanic processes are governed by several complexes of factors, amongst which are: (1) the properties of the magma, (2) the nature of the surface at the place of eruption, (3) the character of the medium covering the surface at the particular place. The morphological volcanic system is set up on the basis of such variations, and the factor of particular interest in the present connection is group 3: variations in volcanic eruptions produced by differences in the covering medium. In this respect we have to distinguish between subaerial, submarine, sublacustrine, and subglacial eruptions.

The study of volcanic activity however meets with a number of serious technical obstacles, due especially to the enormous violence of the processes. Hitherto most research has occupied itself with the subaerial forms of eruption, because they are more frequent and more easily accessible for observation than the other types; but even in this field of study such great difficulties of a technical kind have been encountered that our knowledge of fundamental questions is very incomplete. Still greater are the difficulties of studying eruptions which take place under water and ice, and the material for observation here is very small.

One must assume *a priori* that subglacial eruptions proceed in a manner entirely different from the subaerial, but no scientist has ever witnessed one of them or visited the scene of the eruption immediately after a period of activity. Our knowledge is essentially based upon the observations made in the course of centuries by Icelandic farmers during the eruptions in Vatnajökull and Mýrdals-Eyjafallajökull. Their observations almost exclusively concern a secondary phenomenon, the so-called *jökulhlaup*, which means the violent outburst of water at the margin of the ice, whereby great quantities of ice, gravel, and sand are set free and carried over the landscape lying outside the ice-margin.

The sudden outbreak of large quantities of water is familiar at many marginal areas in various parts of the world, and is commonly due to the tapping of ice-dammed lakes. These floods are also known in Iceland, but are not of nearly the same effect as the tremendous floods forming in conjunction with volcanic eruptions under the glaciers. Few natural catastrophes can compare with these in violence. Time after time they have ravaged the coastal areas south of the great glaciers; but with marvellous tenacity and adaptability the people there have succeeded in establishing themselves in

such a manner that, despite the frequent recurrence of these events, the loss of life and property is exceedingly small.

The Icelandic name for these floods, *jökulhlaup*, is usually translated into the different foreign languages in a rather distorted form, such as jökellöb, Gletscherlauf, iceflood, or glacier-burst. The literal translation of the word is glacier-burst.

Late in the evening of 31 March 1934 I was informed in Copenhagen that a volcanic eruption was in progress in Vatnajökull of such magnitude that the flashes from the ash column could be seen from Reykjavík. The glacial river Skeiðará had swollen, and the glacier itself had been burst by the enormous efflux of water. Despite the brevity of the message, it was easy to understand that this was a typical Vatnajökull phenomenon: one of the volcanic eruptions under the ice-cap which occur at almost regular intervals, accompanied by a jökulhlaup.

Very little being known of the course and results of these subglacial volcanic eruptions, and the processes being numbered among the greatest natural catastrophes in the world, comprising, furthermore, a number of geological problems of wide importance, I realized at once that the opportunity for scientific observation of the eruption should not be missed, if there was any reasonable chance of carrying it through. It was no simple matter however. If a satisfactory result were to be obtained, the main condition was to get to the scene of events with the utmost speed, it being reasonable to assume that the chances of tracing the main features of the process would be much better during the final phase of the eruption than at any other time. While the paroxysm itself lasted there would probably be little that could be done, and after it was over the changes in the snow and the ice-cap round about the zone of the eruption would be so considerable that the results of the eruption in a very short time would be destroyed, or at any rate so modified that a reconstruction would be difficult.

I considered the possibility of starting an aerial expedition from Copenhagen *via* The Faroes to Hornafjörður, south-east of Vatnajökull. The distance from there to the eruption zone is only about 100 km., and given good weather it would be much the quickest way of getting there. However, an aerial expedition can offer but limited possibilities for work. Under favourable conditions one could fly over Vatnajökull, but our observations would be confined to what we could see from the air, and according to all calculations the place of eruption itself would be hidden; nor could one expect to be able to fly through the ash and vapour column on account of the violent atmospheric disturbances. Landing on the glacier would scarcely be practicable, and in any case only for very brief visits. Consequently an expedition to the eruption would have to be in the form of a sledge journey, and, as I could not expect to get horses to travel on the glacier, I had from the start to work on the basis of doing the glacier journey on foot, and hauling sledges.

A variety of circumstances is responsible for the fact that no previous attempt has ever been made to get to the eruption zones on Vatnajökull during or immediately subsequent to their activity; one of these circum-

stances deserves mention because there has been an important change in respect of it.

Admirable work has been done in Iceland to improve traffic conditions during the past ten or fifteen years. The country has no railways, as it was considered best, both economically and for communications as a whole, to construct roads and bridges and base the land traffic on the motor car. This attitude seems quite justified. Large areas of the country can now be travelled by car in the snow-free periods and in fact to some extent in winter. In the regions bordering on the roads however and also in the roadless areas, the people are to a great extent dependent on the season and weather, and therefore it is impossible to say beforehand whether or not a car can get through. I was aware that in the summer of 1933 a motor trip had been made from Reykjavík to the region south of Vatnajökull, and in one case in fact right along the south coast to Hornafjörður; but the question was whether I could get through so early in the year (the beginning of April). I was unable to obtain any information on the point, the only guidance I could get being the weather charts for the previous fourteen days. As these showed that the south part of the island had had a positive temperature and calm, dry weather during that period, I decided to lay my plans on the assumption that the route was passable.

The next technical problem was to get from human habitation on to the glacier itself. I had the choice of two starting points, the farm Kálfafell or the farm Núpsstaður, from which to endeavour to advance as far as possible on horseback. At best I could expect to get through Djúpárdalur to the ice-margin south-west of Hágöngur, but great difficulties were to be expected, whether travelling with horses or with sledges. No information was available as to the snow in the region, nor was the state of the river known; but I presumed that when I got so far that horses were no longer any help, it ought to be possible to find a route that was passable for sledges.

The third and most serious difficulty was to be expected on the glacier itself. There would be a rather soft surface of new snow, but in addition the glacier in all probability would be covered with a layer of volcanic ash, increasing in thickness the closer I approached to the place of eruption. It was indeed problematical whether we could advance at all with sledges, and on the other hand the chances of our expedition succeeding rested entirely on that factor. In itself soft snow is a serious obstacle to travelling, but a covering of volcanic ash and gravel aggravates the situation beyond all computation.

Finally there was the question of the condition of the eruption zone itself for travelling; there was every reason for feeling anxious on that point for it was impossible beforehand to have the faintest conception of what the surface of the glacier was like; but if it were possible to get so near the centre of events, the difficulties there would no doubt be surmountable too.

Thus in all three stages of the journey there was an element of great uncertainty; as the situation lay however there were such possibilities of success that I considered I ought to take this outstanding chance of acquiring some knowledge of such a tremendous natural phenomenon: a volcanic eruption under a glacier.

If anything were to be done, quick action was necessary, and when on

the afternoon of April 3 I had taken my decision, I at once approached the Board of the Carlsberg Foundation and laid before it my plans and also my scruples. The next day the Chairman of the Board informed me that it had been decided to grant my application for the money necessary to carry out the plan, and I cannot too eloquently express my gratitude for the confidence thus reposed in me. The rapid ensuring of the financial side of the expedition made a very hasty departure possible, and was essential to the successful completion of the work. On April 5 most of the baggage left Copenhagen for Reykjavík *via* Hull, and on the 7th the two Danish members of the expedition followed the same route, arriving in Iceland on April 15.

Our task was to reach the centre of eruption in Vatnajökull, travelling as hard as possible. The first question was whether we could go by car along the south coast to the region south of Vatnajökull, and this was rather difficult because the spring was approaching, and the thaw had begun, but there was still frozen ground beneath. Thus conditions for travelling were rather hard. In four days we succeeded in arriving at Kálfafell, a farm south of Vatnajökull, and there we had ordered men and ponies to be at our disposal, so as to start immediately after our arrival. We took all our equipment this way, on pack-ponies to the ice-edge. The journey on the ice-cap itself was carried out with Nansen sledges and in 1936 we also took ponies on the ice-cap.

One of the questions was: which route to choose. It could hardly be considered possible to go directly along Skeiðarárjökull, because the melt-water floods had probably made it impossible or at least the obstacles were so serious that it was most desirable to go another way. I then decided to climb the ice-edge west of Hágöngur at some place where ice conditions were not too bad, and from there to proceed towards the north and later on to the east, in order to reach a height above the place of eruption. The danger from new eruptions here was less.

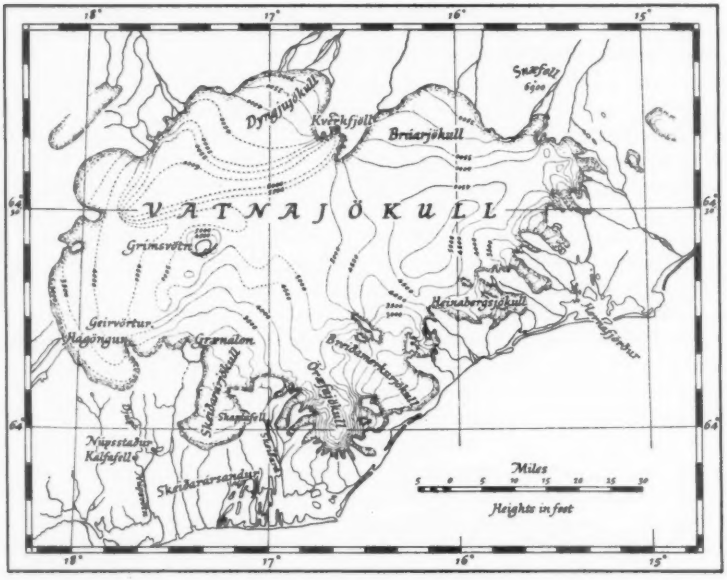
The first evidence of the eruption was a sheep suffering from a disease caused by poisonous volcanic ejecta, with lesions in nose and mouth, and the hair falling off round the mouth. In serious cases the disease is very dangerous to the whole stock of domesticated animals, and even to men. In 1783 between 70 and 80 per cent. of the entire stock was killed, and 20 per cent. of the population, by poisoning and hunger. Recent Danish investigations show that the volcano disease is at least partly a fluor-poisoning caused by the high content of fluorine in the volcanic ash.

In climatic respects the most important feature of Vatnajökull has already been stated by Brian Roberts and Watts: the frequent occurrence of gales and hurricanes; and it has also been stated that we have an enormous amount of snow. In 1934 we considered the snow remarkable and unusual, and thought that we had bad luck with the weather, but in 1936 we learned better. In a gale that lasted for three weeks we got about four metres of snow. When you get more than two metres it is rather hard to keep your tents from being crushed. Your depots also will be covered, and it may be very difficult to find them.

Of the active volcanoes in Iceland, that is to say, volcanoes that have

been in action during the last 1000 years, two centres are submarine, most are subaerial, and some few are subglacial. Practically the whole western part of Vatnajökull seems to be volcanic. At least ten localities in the ice-covered region have been volcanically active during recent centuries. But until now we have only had exact knowledge of five: Öræfajökull, Kverkfjöll, Grímsvötn, Hágöngur, and a locality at the western ice-edge.

The two main features of the volcanic activity under the ice-cap are the formation of the enormous floods of melt-water that disturb the ice-edge and carry a great number of icebergs from the ice-edge down to the sand and away to the ocean, and the volcanic eruption itself.



South-east Iceland, showing the position of Vatnajökull

The map represents the scene of the glacier-burst. To the north Skeiðarárjökull descends from the *firn* cap of Vatnajökull with a rounded ice-edge going down to an outwash plain (Ice. sandr) named Skeiðarársandur. Under normal conditions you find two great rivers carrying the melt-water to the Atlantic: to the west the Núpsvötn, and to the east the Skeiðará. On 22 March 1934 a farmer named Hannes, who lives on a little farm here, was on his way east, and when he arrived at the Skeiðará he saw that the river was higher than usual for the time of the year. The water was very muddy and carried small blocks. He at once had the idea that a glacier-burst was approaching, and the following events showed he was right. From day to day the flood rose and culminated on March 30 and 31. Near the glacier the stream was about 9 km. in breadth.

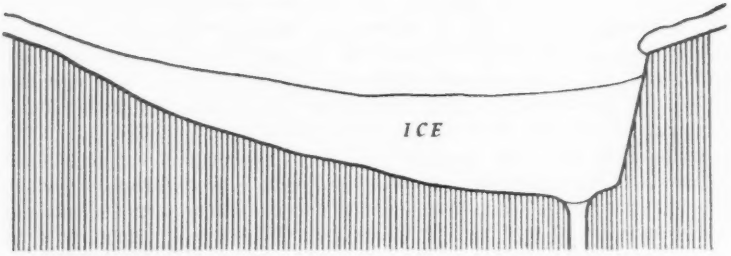
Hannes stayed in Skaptafell some days. It was impossible to cross the sand. The river had swollen to the size of the Amazon, but he wanted to return home as soon as possible, and especially he wanted to return before Easter Sunday. And then, on the Easter Saturday he decided to try to walk—not over the sand but over the glacier. A tremendous flood was proceeding over the sand carrying icebergs and the whole glacier was floating on the streaming waters. The noise was so penetrating that nobody had slept the night before. And that night a volcanic eruption had started 50–60 km. to the north, under the ice-cap. The clouds of vapour and ash stood as a glowing pillar 10–13 km. in height. The explosions from the volcano and the incessant lightning and thunder broke over his head, the gases and ash were driven towards him, but Hannes wanted to come home to celebrate Easter Sunday. It took him 20 hours and gave him many adventures, but his undertaking has shown that the waters of the glacier-burst go under the ice, and that observation has been confirmed in other places.

The valley of Grímsvötn is 7–8 km. from north to south, the depth about 400 m. Before the eruption the valley was probably filled with ice to a certain height. In the first phase of the eruption the volcanic heat partly melted the ice, and a subglacial lake was formed with a floating covering of ice. About March 21 the subglacial lake made its way under Skeiðarárjökull down to the ice-margin, and as the water-level sank, slowly at first and later rapidly, the ice-roof sank. On the fairly even valley bottom it formed a continuous, relatively undisturbed covering, but on the steep sides of the valley it was left as loose blocks, and where it struck against some prominence during its subsidence, the ice covering rested as a dome of ice with radial cracks and decayed into blocks and towers.

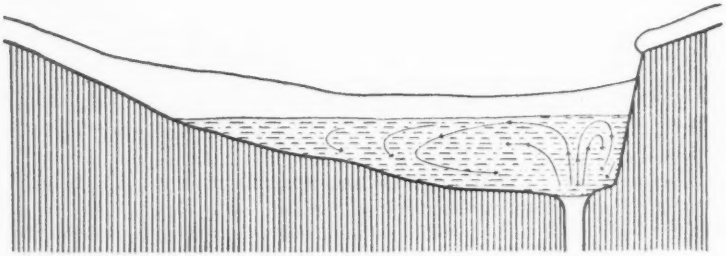
When the ice covering had reached the bottom, the lake being empty, the eruption had sufficient force to penetrate the ice, and it then entered its next phase. Until then the whole eruption had been subglacial and no sign of volcanic activity had been observable; but now the volcano entered a normal subaerial phase, and had still an amount of energy sufficient to form a column of ash and vapour 13 km. into the air.

The direction of the ash-fall is naturally governed by the direction of the wind, and as the wind veers the cloud turns like the cone of rays of a search-light. Thus the whole of Iceland is time after time covered with ash; near the centre of the eruption the fall is heavy; farther away it naturally declines. On our way over the ice-cap in 1934 we had to traverse a surface like this. The glacier surface was covered with a layer of ash, and here and there small patches of fresh snow. It was rather hard work to pull the sledges over such a surface, and for the last five or ten kilometres it was impossible to take our equipment over the ash. That turned out to be serious on our visit to the crater region on May 2, because on the way home to the tents, during the night of the 2nd, we were caught by one of those sudden and violent gales, and we hardly could find the tent.

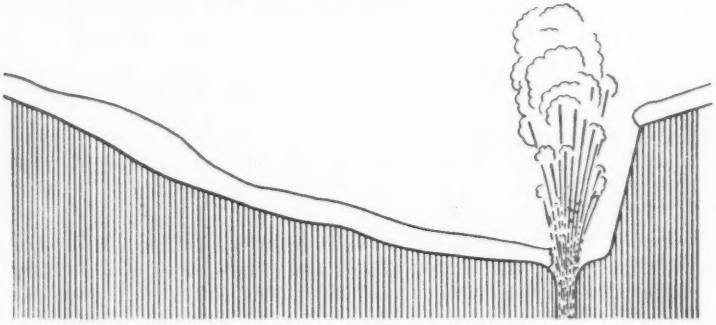
Near the volcano the glacier was deeply covered with ejecta up to a thickness of 25 m. The ash here was still hot, up to 50° C. on the surface. The fresh snow melted under the ash cover, and consequently the ash layer sank



a. Before the eruption. The valley is nearly filled up with ice.



b. The subglacial phase. A subglacial lake has been formed.



c. After the tapping of the lake. The ice roof has sunk down. The volcano has penetrated the ice covering.

Diagram of Grímsvötn showing the phases of the eruption

and formed steaming crevasses. Over the whole region lay the gases from the eruption, somewhat disagreeable to breathe.

Our observations to some degree confirmed Wadell's determination (1920) for the area of the large kettle-shaped valley which he called Sviagígur, and which now is to bear the name of Grímsvötn. It is probable however that the extent from north-east to south-west is 9–10 km., and from south-east to north-west rather less, about 7 km. At the time however there was no possibility of our measuring the horizontal dimensions with exactitude, and we must await the survey of the entire crater region, which it is to be hoped will be made before too much time passes.

Wadell estimated the depth of the valley at 80–100 m., but in 1934 the depth was much greater, over 400 m., measured from the surrounding plateau surface to the top of the ice covering the bottom of the valley. The south wall was the steepest, being almost vertical; in many places the cliff was exposed in profiles quite bare of ice and snow, but, owing to its precipitous nature and the danger of landslides, it was quite inaccessible. The less steep parts of the south wall were covered with ice and loose volcanic materials. The other sides were not nearly so steep; everywhere there was a distinct angle between the almost horizontal bottom and the sides, but the angle of inclination rarely exceeded 20 to 30 degrees anywhere.

The structure of the ice showed that there must be deep subglacial fissures, especially in the south-west and north-west wall. The most pronounced fissure was in the south-west wall, and the longest in the north-west wall, where it could be traced as far as 4–5 km. north of the edge of the plateau. The sides of the valley were covered with a confusion of ice blocks lying in such chaos that it was difficult to discern any regularity in their arrangement. There was a distinct contrast between the bottom, the side, and the surface of the ice-cap above it, and the demarcation between these principal elements of the landscape was extremely sharp.

In the walls to the west and north there were places with a rather more regular ice structure. Here the surface of the ice was domed, with shallow depressions between. The domes were about 500 m. in diameter, and mostly had a pronouncedly radial structure. Some were quite low and regular in form; others were dissolved in the middle into columns and towers of ice surrounded by less-destroyed marginal zones. The height of these columns and towers was presumably between 25 and 50 m., and in certain parts we saw ice walls of from 1–2 km. in length. The region was inaccessible in the short time and with the means at our disposal, so that the dimensions cannot be given with certainty.

On the upper edge of the south-east wall hung a cap of glacier ice, 25–50 m. thick, and covered with an enormous deposit of volcanic ash, which fell in avalanches down to the bottom of the valley 300 or 400 m. below. The narrow gully leading from the eastern corner of Grímsvötn down towards the valley of Skeiðarárjökull was choked with a chaotic accumulation of ice blocks, and was quite inaccessible. Everything bore the impression of unrest and instability. Blocks and walls of ice overturned almost incessantly; enormous masses weighing thousands of tons crashed down; there was an almost

continuous thunder of avalanches of ice from every part of the field, and there was not one moment of complete silence during our sojourn at the crater zone.

The valley bottom was covered with ice, even after the eruption; only here and there did a steep crag or a slope jut out through the masses of fallen ice, and the superimposed deposits of ash, which in parts were covered with fresh snow. The cover of ice at the bottom was strikingly level and apparently undisturbed by the recent catastrophes; with the exception of the crater regions themselves, that is to say, the small areas of less than a square kilometre where the subaerial eruption phase had gone through, it was unbroken, right up to the edge of the vertical wall of ice forming the boundary of the still active east crater. Even at a distance of a few hundred metres from this edge the glacier structure did not vary much from what one finds on a normal glacier. Naturally there was some unrest along the edge of the ice-wall. Large and small blocks of ice detached themselves at intervals from the vertical face and crashed into the hot crater, where the ice quickly melted and evaporated.

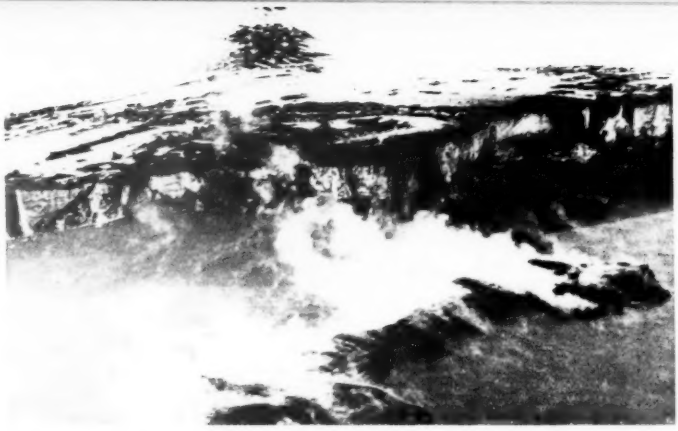
We do not know the thickness of the ice on the bottom of the valley, but as the vertical ice-wall surrounding three-fourths of the east crater was about 50 m. thick, the probability is that its height represents that thickness.

When we arrived at Grímsvötn we were able to establish the fact that the volcanic activity had broken through the ice at two places and formed craters of a kind, through which large quantities of eruptives had forced their way. Both craters were in the bottom of the valley; one, the east crater, lying right up against the south-east cliff, the other, the west crater, in the south-west corner of the valley.

The west crater had formed a cone of ash about 100–200 m. high, with steep sides, resting against the wall of the valley. The eruption itself had ceased, but there was such a tremendous output of steam over the entire surface of the cone, and especially in the vent at the top, that observation was a matter of extreme difficulty. As far as could be seen the cone had a foot of glacier ice, but otherwise had an appearance quite like normal subaerial ash cones of new date; the ash was quite hot, but scarcely so hot as at the east crater, for the fresh snow was not at all melted away, whereas the ash from the east crater was practically bare of snow. This would seem to indicate that the west crater had ceased its activity first.

About May 1, or a month after the beginning of the eruption, the east crater appeared in the form of an oval hole in the bottom of the valley, its greater dimension running almost north-east to south-west for about 1 km. The extreme breadth was about 500 m. The crater lay right against the cliff, which was warm, bare of snow, and dry. No ash cone had formed round the vent, which on the south-east side was bounded by the cliff, whereas the other three sides were bounded by the already mentioned ice-wall about 50 m. high.

The bottom of the crater was formed by an almost flat surface of black gravel, but only about half of its area was visible, the remainder being occupied by a small, steaming pool lying in the crater and filling its south-east part. Almost in the middle of the hole and surrounded on all sides by the pool, was a mound about 500 m. long, 50–100 m. wide, and about 20 m. high. Its shape was very irregular, curved here and there



Grimsvötn, 2 May 1934. The crater during the eruption. The valley bottom in the background is covered with new snow.

The glacier, 1934, covered with partly melted snow and hot volcanic ash

Grimsvötn, 1936. Block of ice covered by volcanic ash about to fall into the valley

Grimsvötn, 1934, showing the steaming crater lake. The valley sides are covered with broken ice

Grimsvötn, 1936, showing the valley filled again with ice and snow

with small lateral spurs. Some transversal eminences and cracks were observed, but otherwise the surface, as far as could be seen from a distance of 200–300 m., consisted of black, vesicular, volcanic scoriaceous material. The temperature must have been very high, but no glowing masses were seen. From the entire island emanated considerable quantities of vapour, which however was especially concentrated in cracks and holes. There was also a lively development of vapour at the line of contact between the island and the surrounding lake, which seemed to be boiling. In some respects the whole island was reminiscent of a leaky steam-pipe. At short intervals there were small eruptions with increased vapour and sometimes a little ash. The output of gases was insignificant while we were present, and it was possible to move about even on the edge of the crater without gas-masks.

One would have expected that the effects of the eruption would be most conspicuous nearest the crater region, but actually, as described above, the greatest disturbances were seen several kilometres away from it. The explanation probably lies in the formation, during the first phase of the eruption, of a subglacial lake with a floating cap of ice. This lake had filled the valley to a considerable height, and in the days from 21 to 31 March 1934 made its way down under Skeiðarárjökull in the manner described above.

It is naturally impossible to arrive at anything like an accurate account of the quantity of water liberated, but an idea of its size is to be had in two different ways. An estimate has been formed of how great was the volume that made its way out over Skeiðarársandur during the burst, and an attempt has been made to estimate how much has disappeared up in the eruption zone.

The volume of water on Skeiðarársandur must be judged from the information obtainable as to the breadth, depth, rate and duration of the flood.

During the paroxysm the width of the stream at the ice-margin was about 8 km. for about 36 hours, and over 2·5 km. for almost 96 hours. At the ice-margin the depth was very great. The channels were about 11 m. deep, the greatest dimension of the ice-blocks transported was usually between 10 and 20 m., and the fracture faces in the ice-margin were 40 m. high. One observation shows a stranded ice-block 15 m. high about 500 m. from the ice-margin. Thus the maximum depth can scarcely be put at less than 15–20 m., but it was not always so great. If we assume a depth of 3–5 m. as the average, we shall certainly not be exaggerating.

The rate of flow also varied, but eye-witnesses put it at much greater than that of normal, swift rivers, for which average speeds of 1–2 m. sec. are the normal. Some guidance is to be had in the particle-size of the material washed in the cones of deposition formed by the glacier-burst. At about 1 km. from the glacier the normal maximum diameter of stones was about 1 m., and still larger blocks were found. Taking it that a flow of 2 m. sec. can transport stones as large as a man's head, there is no doubt that the rate here has been much greater, and it will certainly not be exaggerating if we put it at 2 m. sec.

The duration of the maximum volume and rate of flow was about 36 hours;

if we assume that the volume of water forced out during the other days was equal to 12 hours' paroxysm volume, we may put the total water volume at 48 hours' full activity.

Using these values as a basis we arrive at the following figures for the water volume of the glacier burst:

Width	8000 metres
Depth	5 „
Speed	2 m. sec.

which gives a flow of about 80,000 cu. m. per second; continued for 48 hours it means a water output of (approx.) 14,000,000,000 cu. m.

If we take the flow as being 1 m. sec. and the depth 3 m., we get a water volume of (approx.) 4,000,000,000 cu. m.

The volume of water thrown out cannot have been less than some milliards of cubic metres, but even during future bursts it will be difficult to measure it, because the plain is absolutely unapproachable as long as the catastrophe lasts.

It is possible to form an estimate of the dimensions of the masses of ice melted during the eruption and as a consequence of it.

As already stated, the volcano lies in the bottom of Grímsvötn, a large, ice-filled valley with a bottom area of about 50 sq. km. In the very first phase of the eruption the valley held an enormous mass of ice, which then melted from below; this formed a lake covered with a cap of ice which gradually decreased in thickness. This subglacial lake was tapped at some point of time during the process. Its waters rushed down in the form of a glacier-burst, and the floating ice-cap over the lake sank down and rested on the bottom.

By determining the level of the valley sides to which the destruction of the ice-cap reached it was possible to establish to some degree how high the ice-cap had reached when the eruption began, and the difference in the height of the surface of the cap prior to and after the eruption was scarcely less than 200 m. Accordingly, the quantity of ice that has disappeared may be put approximately at $50 \times 0{\cdot}2 = 10$ cu. km.

Naturally it is difficult to find any exact proof that the waters produced by the glacier-burst really came from the crater valley, but there is hardly any other possibility. It may also be considered as very probable that the liberation of thaw-water (about 10 cu. km.) to a great extent took place between March 20 and April 2, and in the days immediately preceding March 20, even if it be presumed that there is a continuous output of heat in the crater valley in the quiet periods too. The melting undoubtedly is a fairly short process and a direct consequence of the volcanic activity. This is borne out by the catastrophic violence with which the glacier-bursts appear and the often-observed connection with the eruption.

According to the very explicit report given by Thoroddsen of the eruption in 1903, from which we see that the processes in 1903 and 1934 were practically analogous in their course, there is every reason for regarding it as an established fact that this eruption took place in Grímsvötn. In 1922 there was a new eruption in Vatnajökull, which took exactly the same course as

the eruptions in 1903 and 1934, and, judging from Thorkelsson's description, it may likewise be localized to Grímsvötn. Thus we may take it that the three great glacier-bursts in Skeiðarárjökull in the present century have been caused by the forming of a thaw-water lake up in the crater valley as a consequence of volcanic eruption. In the quiescent periods between two eruptions the crater valley is probably filled with ice, originating from glaciers which run into the valley from all sides and from the over-production of snow.

There is another possibility however that cannot entirely be rejected, and that, having regard to future observations, calls for some discussion. It is possible that the heat generated in quiescent periods too is very great, so great that it is able to melt a considerable part of the ice-supply, and that the thaw-water thus liberated collects in the form of a lake on the bottom of the valley. If we assume that it is the increasing volume of the water which, at a given time, causes the lake to be tapped, it may be that the tapping is the primary phenomenon in the combination of glacier-burst and eruption. According to this interpretation the eruption would be a consequence of the lifting of the load caused by the disappearance of the lake.

Briefly the question is this: are the melting of the ice in the crater valley and the glacier-burst consequences of the heat generated in the first phase of the eruption; or is that melting a slow, continuous process, and the eruption merely a consequence of the lifting of the load following upon the tapping of the lake? Without being in a position to advance conclusive arguments in favour of the one or the other view, I must state that my opinion most decidedly is that the melting is a brief process, a direct consequence of the increased heat caused by the eruption in its first phases, and that the eruption must be the cause of the occurrence of the glacier-burst, and not vice versa.

Further, the consumption of heat during the melting of the ice in the valley must be great enough to bind the energy output of the subglacial phase of the eruption, and therefore the eruption only becomes subaerial in character when the water has been tapped away, and the thin cap of ice remaining has sunk down. This sequence can scarcely be questioned. I need merely refer to the repeatedly observed circumstance, which is strongly emphasized in this paper, that the subaerial phase of the eruption only begins at a time when the glacier-burst is almost over.

It is of the greatest importance to future studies of the subglacial eruptions to ascertain whether the valley in quiescent periods fills with ice, or whether the continuous melting is so rapid that the greater part of the ice falling and forming in the valley melts shortly afterwards, and remains there in a fluid state until the next glacier-burst occurs.

To my mind it is unlikely that a volume of water so colossal as 10 cu. km. can be dammed up without any possibility of making its way down through the valley below; in all probability the liberation of the thaw-water has mostly proceeded during the glacier-burst and immediately prior to it.

The volcanic processes in Grímsvötn would thus seem to take place in a regular cycle:

1. The store of ice in the crater valley grows steadily; a small part of it melts, but most of it accumulates in solid form.

2. A new eruption period is initiated with a subglacial phase, during which the energy produced is imprisoned. This takes place mostly in the form of melting heat, even if a certain amount of energy goes towards heating up from about 0° to the much higher temperature which the water must have when it leaves the valley as a glacier-burst. Some heat may also be consumed in evaporation, but the steam generated in this phase must be small, for otherwise one would be able to observe the formation of clouds of vapour, and none have been seen.
3. When the store of ice in the valley has been reduced to a cap of relatively small thickness (in 1934 about 50 m.), and the water has been tapped away, the eruption breaks through the cap, and the next phase provides violent subaerial phenomena: ejection of vapour, ash, bombs, fragments of the substratum, and possibly small quantities of lava.
4. After a paroxysm lasting about two weeks, the activity declines little by little; sometimes a revival of the eruption is observed in the course of the following year, whereafter the next period of quiescence begins.

Provided that this theory of the sequence and connection of the phenomena is correct, it is possible to form an idea of the dimensions of the energy released during the subglacial phase described above.

The crater valley in Vatnajökull must simply be used as an ice-calorimeter. On the basis of the data given above the volume of water liberated by the glacier burst may be estimated at about 10 cu. km. The melting of a corresponding volume of ice requires a total heat of $10^{10} \times 10^3 \times 80 = 8 \times 10^{14}$ kg. cal. apart from temperature increase, evaporation and loss in other ways. Putting the subglacial eruption period at about twenty days, the average daily supply of energy must be 4×10^{13} kg. cal.

Reference may here be made to the measurements taken of the heat output of the Kilauea lava-lake by Wolff, which has been calculated at $3{\cdot}2 \times 10^{10}$ kg. cal. per day. That the daily heat output in Grímsvötn during an eruption is 1000 times as great as that from the Kilauea lava-lake is not at all surprising, when it is remembered that the lava-lake is a relatively stationary phenomenon, whereas the eruption in Vatnajökull is a paroxysm.

Even if this numerical evaluation of the output of energy is encumbered with considerable uncertainty, it is at any rate clear that large quantities of energy are carried to the crater region at a time when it is covered with water and ice. The problem then becomes: how is it possible to carry such large amounts of energy to the surface of the Earth under circumstances like these? One might think, *a priori*, that a large part of the energy required for melting the ice would be released by the cooling and coagulation of the magma. If we now endeavour to calculate what quantity of magma is required to melt about 10 cu. km. of ice, we arrive at the following result.

Basalt magma has a specific gravity of about 2·7, a specific heat of 0·2 and a melting heat of 100 calories. If we reckon with a cooling down from 1200° to 0°, the coagulation and cooling of a magma of 1 cu. km. will liberate $10^9 \times 2{\cdot}7 \times (240 + 100)$ cal. $= 9{\cdot}2 \times 10^{14}$ cal., *i.e.* an amount of energy of the same value as that which must have been expended in melting the ice of the crater valley before the glacier burst. If the energy originates from the

Ice blocks and gravel carried away by the jökulhlaup

Ice tunnel formed at the bottom of the glacier by the melt water from the eruption of 1934

The ice margin in 1936. The glacier is recovering from the jökulhlaup

Stone pavement deposited by the jökulhlaup

Skeiðarársandur strewn with blocks of ice

magma's store of thermic energy, 1 cu. km. of magma would have to be ejected during the subglacial phase. This is not very probable, because until March 31 the crater had certainly been closed over, the passage from the magma container having been barred by water and ice, and that barrier would undoubtedly burst under so colossal a magma ejection; one would also expect that in that case Grímsvötn would be full of coagulation products.

This forces us to consider whether under these circumstances exothermal processes did not take place in the upper part of the magma, either chemical transformations or the condensation of gases, for example steam, which would thus act as a kind of energy carrier. In large negative temperature changes such as were involved here, we must at any rate assume that exothermal processes are bound to take place when fairly great quantities of heat are liberated by the condensation of the vapours.

Even if with such tremendous transformations of energy as these we get beyond dimensions usually controllable by science, it should be possible, by following the processes between two successive eruptions in Grímsvötn, to attain to a fairly acceptable measurement of how much ice is accumulated, and when its melting takes place; and even if there is great uncertainty about material now published, it gives an indication of the amount of energy liberated by a volcanic eruption. Thus the foregoing should be regarded rather as a working programme than as a result, and one of the great tasks for future volcanological research will undoubtedly be to employ Grímsvötn as a natural ice calorimeter.

In the central part of Vatnajökull we saw from a distance little areas free from snow, even after heavy snowfall. I thought that it was due to the action of wind, but when we came to the place we observed that the rock was hot. In fissures the temperature rose to about 100° C. Steam rose from the fissures and was condensed into ice and rime. Some few mosses and lichens had found the place in spite of the fact that the distance to other plant-covered areas was at least 50 km.

In 1934 April and May we crossed the area west of Hágöngur for the last time in extremely bad weather, but without any difficulty at all. We did not even need to use the rope. Two months later a German expedition tried to follow the same route, but found it completely inaccessible, the whole glacier being destroyed in blocks and crevasses. In 1936 the glacier was still very crevassed; the ice-blocks are more than 50 m. high.

Although no sign of an eruption had been observed, we must assume that a subglacial volcano had been in action in the area. The river Djúpá, which originates from the ice-margin, was in flood during the whole summer of 1934, and now we have buried proofs that some lava eruptions are not able to penetrate an ice-cap. The melting of the ice proceeds gradually, the lava forming a flat domed cake between rock and ice. In the study of the geology of Iceland this phenomenon is of the greatest importance. The Scotsmen, Tyrrell and Peacock, have done pioneer work in this subject, and I must also mention the investigations of Dr. F. W. Anderson, of Edinburgh, during the Cambridge Expedition to Vatnajökull in 1932.

Geologically as well as volcanologically those two types of eruption are

most interesting. It is quite clear that these two eruptions, the Grímsvötn eruption and that west of Hágöngur, are very different in energy. The Grímsvötn eruption had the strength to melt 10 cu. km. of ice and after that to penetrate the ice cover and send a column of about 10 km. height into the air for several weeks; and the Hágöngur eruption could not even penetrate a thin ice-cap of about 100–200 m. And what is most astonishing is that the Grímsvötn eruption seems to be poor in ash material and enormously energetic, while the Hágöngur eruption probably produced a considerable amount of lava and very little energy.

In 1936 a new expedition (IV. Dano-Icelandic Expedition) went to Vatnajökull to study the changes in the zone of eruption. The expedition started in April and worked on the ice-cap for nearly two months. Afterwards, until the end of July, the expedition studied the different facies of the so-called Palagonite formation. The bottom of the valley Grímsvötn has now been completely cooled, and as far as can be judged from the present material, Grímsvötn will be filled to a certain extent by ice before the next eruption, which may be expected about 1945–50.

The theory of connection and sequence of the phenomena mentioned in this paper has thus been confirmed, and it is to be hoped that future studies in this highly interesting region will permit a still more detailed understanding of volcanism under the ice-cap.

DISCUSSION

Before the paper the CHAIRMAN (Major-General Sir PERCY COX) said: The paper to-night is on an extremely interesting and unique subject, the eruption of a volcano under an ice-cap, which is an eruption, practically, under a glacier. Dr. Nielsen who is to read the paper is no stranger to us: he has been with the Society before. He was here when Mr. John Wright read a paper on the Hagavatn Gorge in Iceland. He is Secretary of the Royal Danish Geographical Society and has spent the last thirteen or fourteen years making a special study of the geology and the physiography of Iceland. His lecture will be accompanied by some beautiful slides, and I am sure both the subject and the slides will be of very great interest to us. I ask Dr. Nielsen now to read his paper.

Dr. Nielsen then read the paper printed above, and a discussion followed.

The CHAIRMAN: H.E. the Danish Minister is with us, and I will ask him to say a few words.

H.E. THE DANISH MINISTER: In the diplomatic world I am a dual personality, representing the two independent kingdoms of Denmark and Iceland, and I have to-night the privilege, in my capacity as Icelandic minister, of expressing my great appreciation of the fascinating lecture given by Dr. Nielsen. But what perhaps gives me the greatest pleasure is to tender my heartfelt thanks to the Royal Geographical Society for again giving us encouragement. Danish explorers have always told me that they consider your Society to be a second scientific allegiance, and I hope that that friendship and collaboration will last for many years to come.

Mr. J. A. STEERS: There must be many here to-night who know far more of Iceland than I do. On the other hand I do know Dr. Nielsen, and a year or so ago spent a very happy time with him on the west Danish marshes, following on his own visit to the Fens and the Norfolk coast.

I have been greatly interested in what Dr. Nielsen has told us this evening. I would like to have been with him. He has described an unusual event, and has, I believe, the unique advantage of having visited the source of the eruption almost before the cessation of volcanic activity. To one whose acquaintance with glaciers is limited to the Alps and Norway, his studies and pictures of the distribution of ejectamenta of all sizes—especially volcanic dust—are of great interest. Measurements in physiographical studies are always desirable, and Dr. Nielsen's observations of the disposition of this material are of particular value. Presumably much of this material sooner or later finds its way to the coast and is there re-distributed by waves and built up into coastal features.

The phenomena described have also been shown to be factors of no small importance in the human geography of the area. The population is sparse, but the effects are not the less significant. The account of the effects of volcanic gases on sheep is also of interest. The enormous power generated by the swollen torrents and the distributions of the volcanic ash give some idea of the importance of these paroxysms. It is easy to build opinions on the commonplace happenings of every day, without making sufficient allowance for catastrophes of the kind described to-night.

I was also very glad Dr. Nielsen included cinematographic pictures of the Icelandic geysers. We were thus able to get a far better idea of these features than can be obtained from books or lantern slides. Iceland is becoming more and more a centre of scientific interest and to any one, like myself, whose field experience has been in vastly different regions, a lecture such as we have had to-night brings real enlightenment on its physiographical problems.

Those who follow me can discuss the particular glaciological problems in detail, but I should like to take this opportunity of expressing my thanks to Dr. Nielsen for his most interesting lecture and congratulating him—and I know I may do this on behalf of all here to-night—on the admirable way in which he has carried out the difficult task of addressing us in our own language.

The CHAIRMAN: Mr. Lewis is about to go to Iceland. We should like to hear a few words from him.

Mr. W. V. LEWIS: Perhaps it is rather presumptuous on my part to add my mite to the congratulations, but nevertheless I should like to congratulate Dr. Nielsen most heartily on the real addition he has made to our knowledge of Icelandic glaciology and volcanology. It is not often those two sciences meet at such close quarters. There are several reasons why I am particularly glad to have had the opportunity of hearing this lecture. In the little interest I have been able to take in Iceland in the past I have been grateful to Dr. Nielsen for his already very valuable contribution to Icelandic physiography, but to-night it is evident that he has given us a real tit-bit from the scientific point of view.

The speed with which Dr. Nielsen organized the expedition must be unique. Only three days after he made his decision he was on his way to Iceland. Any one who has organized anything more than an ordinary holiday trip can realize what an enormous amount there is to do. The fact that Dr. Nielsen arranged a first-class expedition in three days speaks for itself. Then there is Dr. Nielsen's detective work. Those long totals with dozens of noughts were the result of a great amount of calculation. He used every available shred of evidence and then reconstructed "the crime" before our eyes, and I am quite certain that if his Icelandic friends had not told him that the flood lasted from forty-six to forty-eight hours he would have sought for and found that information in the chaos of icebergs and boulders scattered about the gravel-strewn plains.

Dr. Nielsen referred to a lake under the ice-cap and I wish to ask a question

on this point. Am I right in assuming that the actual floor of the lake is everywhere sloping down towards Skeiðarárjökull, or does it occupy a hollow from which perhaps it syphons out? If the former case is true, which appears the more likely, then the English language has no term conveying the idea of a volume of water covering many square miles which has not a horizontal surface and a concave floor, but a more or less level or gently tilted floor and a convex upper surface hemmed in by the ice-cap.

Lastly, Dr. Nielsen is extremely generous to other possible explanations of the nature of the volcanicity. He does not stress his own interpretation; he guardedly suggests—and I am most certainly prepared to believe him—that the peak quantity of flood water is the accumulation solely of the actual volcanic outburst. But he also offers the suggestion that it might be accumulating slowly over a period of years. If that were so, would it not show up in the volume of the melt-water pouring out from Skeiðarárjökull? Is the régime of the Skeiðará any different from that of other glacial streams in Iceland, as one would expect it to be were there a supply of melt-water from volcanic heat?

Dr. K. S. SANDFORD: It is a great privilege to be invited to come on to this platform and to congratulate Dr. Niels Nielsen on his paper. To-night has been a real feast for geologists and geographers. We knew that a struggle between volcanic and glacial activity went on in Iceland, but in this country we did not realize what it meant.

If you try to find something of this sort in the ordinary text-book you will find some reference to Whymper's account, in 'Travels among the Great Andes of the Equator,' of an eruption in 1877, when the lava in the crater of Cotopaxi overflowed on to the glacier. Floods brought blocks of ice down the side of the volcano and flowed for 300 miles; they were of great force: heavy machinery of some cotton mills, for instance, was carried about 30 miles. But you do not read in text-books of a considerable part of a glacier being melted from below and carried away, and icebergs 100 feet high being carried off also.

I do not think Dr. Nielsen told us enough of the astounding difficulties of this journey. Sledging in summer over melting snow is unpleasant. When you have falls of something like 3 or 4 metres of snow it is discouraging. When you cover that with ash, sledging really should become absurd and when that ash is hot and melts the snow, impossible. These are real difficulties that Dr. Nielsen has overcome, and thereby he has been enabled to give us a very fine account, clearly expressed and illustrated by beautiful photographs.

The CHAIRMAN: Mr. John Wright gave us a paper two years ago on the Hagavatn gorge; he knows the region described to-night, and it would therefore be interesting to hear some remarks from him.

Mr. JOHN WRIGHT: The first point that struck me in connection with the catastrophe, of which Dr. Nielsen has given an account, was the immense size of the volume of water involved. In the same year, 1934, I was working farther west in Iceland investigating the results of a lake flood which had taken place on another ice-cap there, and we worked out the volume of water as far as we could and compared it with accounts of glacier lake bursts which have taken place in other parts of the world. It was only about one-hundredth of the size of the volume of water of which we have heard to-night. Yet that flood was able to cut a gorge about a quarter of a mile long and 200 feet deep, and it shows what the other flood could have done had it been applied to a similar kind of terrain.

There are one or two questions I should like to ask Dr. Nielsen. First of all, as to whether he noticed any rounding of the boulders which were carried down by the water, because we found in one or two old stream channels, which had

been occupied by the flood-water, places where the rock had been hollowed right out and at the bottom a little nest of boulders, two or three feet across sometimes, just like the nest of some vast bird, completely rounded by the swirling of the water.

The other point is in connection with the lava flowing out under the ice-cap, to which Dr. Nielsen referred briefly. Did he notice in the pillow lava massive blocks like roots of trees branching out in all directions, which looked as though they had ice on them, when the lava flowed out?

I do not think I have anything more to add except to thank Dr. Nielsen very much for his lecture and congratulate him on the beautiful pictures and film which he has shown.

Dr. NIELS NIELSEN: I would like to say, in answer to the question asked by Mr. Lewis, that the possibility of other sources of melting water cannot be completely denied. Where it is a question of actual determination of the amount of water, in order to estimate such a fundamental problem as the heat production, one cannot be too careful. It seems to me highly probable that the major portion of the melt-water must be produced by the eruption, but it would however be impossible for me to say anything definite in that connection.

To Mr. Wright I would say that we have seen the rounding of the boulders, but I am not sure that the rounding of boulders in a glacier-burst is due to the action of the glacier itself. It might have taken place before the glacier-burst, under the glacier or under the ice.

We also saw pillow lava that resembled roots of trees, but it seems to me that that is somewhat dependent upon the section. If you make one section through the pillow lava you get one picture, and if you make another section through the same lava you get quite another picture. I think that the whole phenomenon is really not so complicated as one would perhaps at first sight suppose.

The CHAIRMAN: I very much regret having to bring this most interesting evening to an end, but the hour is late and there is no time for other speakers. You will remember that Mr. Brian Roberts, to whom Dr. Nielsen referred as having been to Vatnajökull in 1922, is now with the Rymill expedition in the Antarctic.

When the lecturer opened his address I think most of us envied him; certainly my mouth watered when he spoke of the institution to which he went one evening to ask for funds to carry out this journey, and received those funds the next morning! If there could be such a body set up in London it would indeed be a boon.

Our gathering to-night has been graced by the presence of H.E. the Danish Minister and his lady. They are no strangers to this Society and their presence is another instance of the sympathy, the camaraderie, and community of interest which we have with our Danish friends in these matters of exploration in Greenland, Iceland, and that region generally. We always have great reason to appreciate the help we get from our Danish friends, and we thank Dr. Nielsen extremely for coming over here to-night to give us this unique talk. He has illustrated it by some wonderful photographs, and is greatly to be congratulated on his success in getting so close up as to be able to take such pictures. I ask you now to join me in enthusiastically thanking him for his very fine lecture and for the charming way in which he addressed us in our own language.

LAND AND LABOUR IN A CROSS RIVER VILLAGE, SOUTHERN NIGERIA

C. DARYLL FORDE

Afternoon Meeting of the Society, 15 March 1937

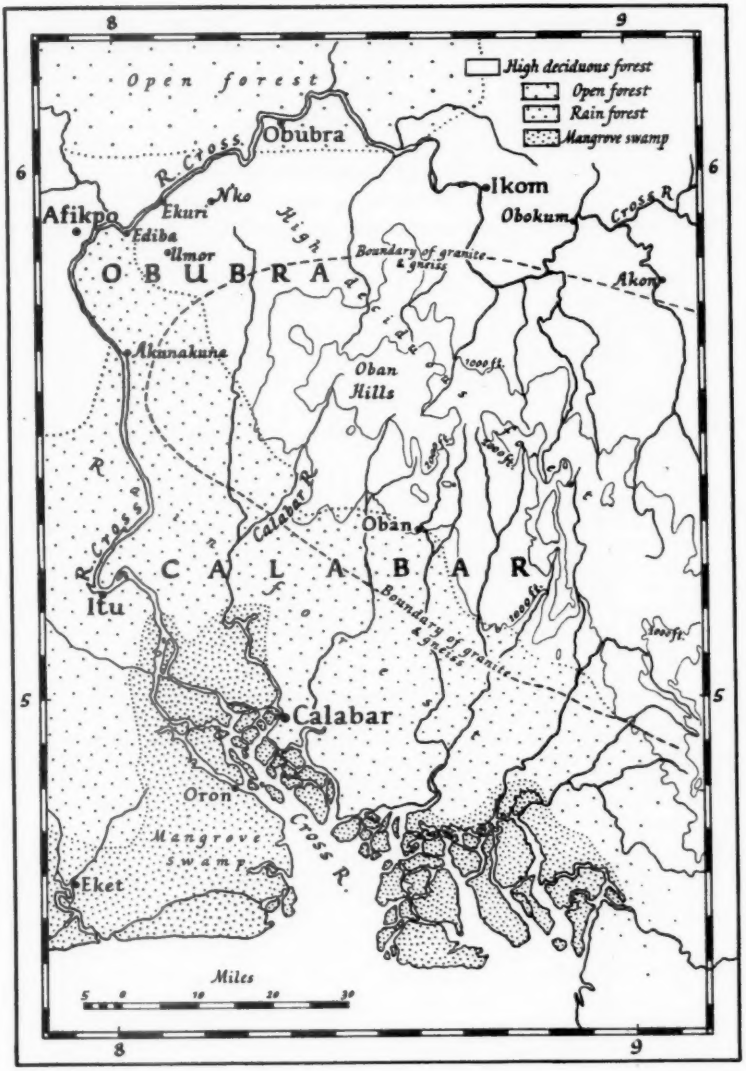
THE expedition to the Cross River country in Southern Nigeria, of which this paper outlines some preliminary results, was made possible by the generosity of the Leverhulme Research Fellowships Fund and by the courtesy of the Nigerian Government, to both of whom my sincere thanks are due. I arrived at Calabar towards the end of July 1935 and proceeded up the Cross River by paddle boat to Obubra. After a short reconnaissance of the country lying on either side of the Cross River in the Obubra and Abakaliki Divisions I decided to work in the village of Umor, and it is the territory and economy of this village community that I shall attempt to describe here.

My main objective was the investigation of the economic life of a community of hoe cultivators in the West African forest zone, and I was concerned with the relations of this economy to both physical environment and social organization. For this purpose it was necessary to select a group who would not only assent cheerfully to the sudden appearance of a European resident in their village but would also take kindly to detailed and persistent inquiries concerning that often difficult and even dangerous topic—the land. I was also anxious to avoid in this instance a people whose economic life was deeply affected by an external market and whose agriculture and equipment had been extensively modified by the needs and opportunities of modern trade. These conditions were largely met in Umor and to its people I owe a very great deal for their quick friendliness and their general freedom from suspicion. I was accompanied for the greater part of the period by my wife and by Mr. A. P. Brown, an artist who found time in the intervals of his painting to give me much valued help in survey work and also in the collection of data on the forest flora. We were readily accepted as residents in the village, and although there were inevitable barriers of custom which made some lines of inquiry difficult, I was, so far as ease of human relations was concerned, particularly fortunate in my choice.

The village territory

Umor[1] (lat. 5° 50′ N., long. 8° 10′ E.) is one of five settlements of a semi-Bantu linguistic group known as Yakö. The village itself lies 7 miles east of the Cross River and, although only 70 miles north of Calabar in a direct line, it is about 120 miles away by river. It is a large compact settlement covering an area of nearly a quarter of a square mile and, like the other Yakö villages, is economically and territorially autonomous and has an independent native political organization. Approximately 11,000 people live in Umor, and the territory claimed by the village has an area of 47 square miles, so that the density of population in the village territory as a whole is approximately

[1] Usually named Ugep by the riverside peoples, and on Nigerian Survey and other maps.



The Cross River district

230 per square mile.[1] There are at least 4 or 5 square miles of continuous unfarmed forest on the eastern borders and a square mile of uncultivated swamp land in the north-west, but the remainder of the 40 square miles of territory is penetrated by a web of farming paths which give access to periodically cultivated tracts of land on either side as well as affording routes to neighbouring villages (see Fig. 1). Farmed land appears rarely to extend to a distance or more than a quarter of a mile from these main paths while it is often restricted to a fringe only 200 yards on either side, so that there are at present numerous islands of uncultivated land between the more widely spaced farming paths. This, in accordance with my estimates of the aggregate area of land cleared for cultivation, amounts to only 18 square miles, and of this, as will be seen later, a total of only 3 or 4 square miles is actually cultivated in a single year.

The village territory lies athwart a low undulating ridge of Cretaceous sandstone which never rises more than 200 or 300 feet above the level of the Cross River. It is crossed by a multitude of streams which drain broad open valleys aligned roughly parallel with the Cross River, and immediately east of the village a steep cliff face, descended by a precipitous path, overlooks a wide low-lying basin which is drained circuitously by the large Ewiden stream to the Cross River.

[1] The basis for the estimate of population, which differs somewhat from the official estimate in the District records, may be explained here. A "Nominal Roll" of the adult male population of the village had been taken by the District Officer in connection with the tax assessment only a few months before my arrival at Umor. In this roll absentees not expected to return permanently were noted. In the course of my work I made a detailed census of the households of a kin group comprising 112 adult men. Unknown names and double entries of individuals under different names in the Roll of this kin group were largely matched by records in my census of men omitted from the Roll, but a small discrepancy remained. As the household census was a prolonged inquiry which was several times rechecked I have assumed that a discrepancy of this order would be likely to apply to the male population as a whole and have applied the ratio of the discrepancy (112 : 115) to the Nominal Rolls as a whole (less absentees) in estimating the number of adult males in the village. From my census data on the kin group investigated I obtained a ratio of adult females to adult males and also of minors to adults of both sexes. These are 176 adult females per 100 adult males and 123 minors per 100 adults of both sexes. The results may be tabulated as follows:

Number of adult males in Rolls of 1935 (less absentees)	1801
Number of adult males recorded for Ndai kin group in Rolls (less absentees) ..	115

Household census of Ndai Kin Group

Adult males	112	309
Adult females	197	
Minors		380
Total		689

Estimated population of Umor 1935

Adult males	1754
Adult females	3085
Minors	5951
Total	10,790

Climatic conditions

The country lies in the northern part of the forest belt of Southern Nigeria in which there is a clear distinction between the wet and dry seasons. From early in April to the end of October there are heavy rains every few days, followed by a dry season of four months during the climax of which, in December and January, the rainfall is negligible. No climatic records are available for Umor itself, but rainfall data for a period of thirty-one years down

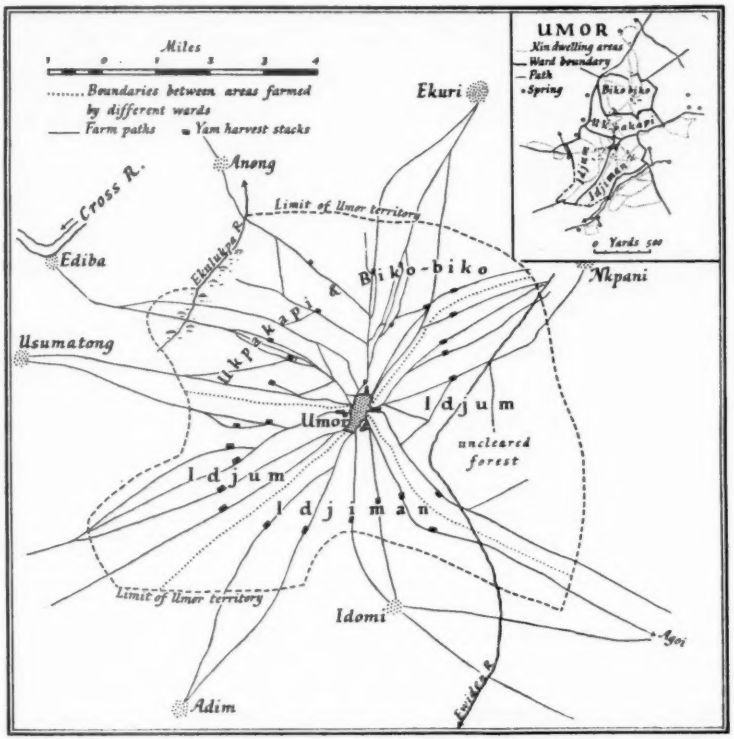


Fig. 1. Sketch-map of Umor

to 1935 are available for Afikpo, a Government station approximately 20 miles to the east (Fig. 2). The Afikpo records give a mean annual rainfall of 80·12 inches, of which 71·65 inches fall during the seven rainy months and only 8·47 inches in the remaining months of the year. The rainfall normally rises to a maximum of about 15 inches in September, and in the period 1931–5, for which more complete data were available, there were on the average twenty-one rainy days in this month. In November the rainfall falls away abruptly, although there were at Umor in 1935 several heavy falls accompanying the violent tornadoes that are characteristic at this season. December is a month

of real drought, while in January and February only occasional light showers occur.

Although this monsoon regime is normal there is an occasional break in the rains in the middle of the wet season. This was very marked at Afikpo in 1932, when only 1·67 inches fell in July, and it is a feature of the climate well known to the natives, who believe it to be very harmful to the yam crop.

Short-period data (9.0 a.m. and 3.0 p.m. shade readings for 1931–5) for Afikpo show a small annual range of temperature which rises to a 9.0 a.m. monthly mean of 79° F. in March at the end of the dry season with increasing insolation. There is a slight fall in April and May with moderate rains and a marked fall from June to August after the onset of the heavier rains. The mean daily range rises from little over 10° F. in the wet season to nearly 20° in the dry season (March, 1931–5: 19·1° F.). The relative humidity is high

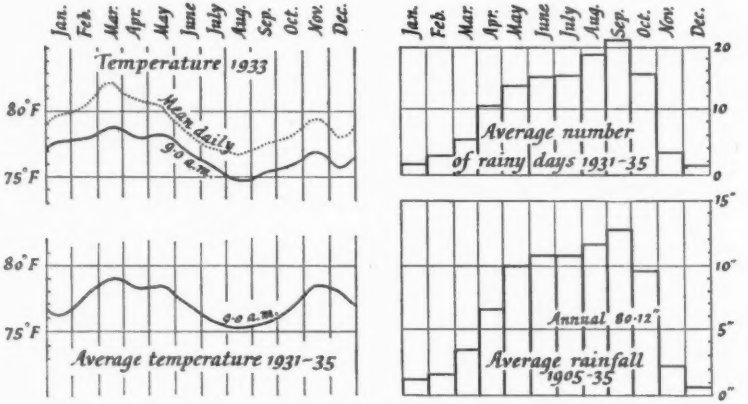


Fig. 2. Climatic data for Afikpo

throughout the year in the early morning, and at Afikpo the monthly mean at 9.0 a.m. is rarely below 85 per cent. in any month, but 3.0 p.m. readings fall to around 60 per cent. in the dry season.

This part of the Cross River region thus lies in the zone of heavy equatorial monsoon rainfall, but the length of the dry season and the period of two months of virtual drought in December and January are likely to affect the composition of the vegetation and the cycle of agricultural activities. The geological and soil conditions over the greater part of the territory of Umor are such as to intensify the effects of the marked dry season, for the Cretaceous sandstone is highly permeable and the soil weathered from it has very low water-holding qualities. (See Appendix.)

The natural vegetation is dense tropical forest which appears to be transitional from the evergreen rain forest to the mixed deciduous forest. This is indicated by botanical data from the general region collected by the Nigerian Forestry Department and by the composition of the dense forest tracts round Umor itself.

The cycle of cultivation

The people of Umor are yam growers; practically every household is a farming unit and the sequence of agricultural tasks and rewards dominates the economic life of the village. The sharp seasonality of rainfall and the moderate natural fertility of the soil are clearly reflected in the agricultural cycle. There is only a single planting at the beginning of the rains each year, and since there is no effective fertilizing, farmland is usually rested for four years after a single harvest has been obtained. Yams, the large tubers of *Discorea* spp., which are the staple food of the people, constitute by far the largest and most important crop. As all other cultivation is subordinated to the requirements of the yam harvest, the calendar of farm work can best be considered in connection with yam cultivation (Fig. 3).

Early in January, after the second moon cycle of the dry season, clearing of the farm lands for the coming season begins. As these tracts have not been

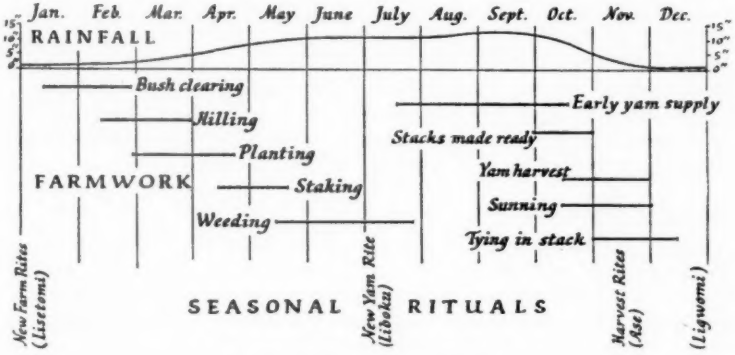


Fig. 3. Calendar of farm work

cultivated for four years they have grown up into a dense bush of saplings and undergrowth about 20 feet high. This is cut down by parties of men, whose formation will be described later, and yam hills are made by women or foreign workers as the clearing progresses.

Planting, undertaken jointly by men and women, follows as soon as the first plot or section of hills has been prepared in each farm and it continues as clearing and hilling progress until the end of April. A number of subsidiary crops such as coco-yams (*Colocasia*), maize, okra, pumpkins and less commonly beans and cassava (*manihot*) are planted after the yams on the slopes of the yam hills. Small patches of ground nuts are also planted, and round the margins of the farm pepper bushes are transplanted from the previous farming site. The preparation and erection of the sticks and strings for the yam vines rest with the men, but all the subsequent tending of the farm, including the heavy task of a double weeding which continues throughout June and July, is done by the women.

In July an early variety of yams (*lidjofi*), which is generally planted in every fifth row of yam hills, is available, but these may not be dug or eaten until

after the performance of the *liboku* rites which are regarded as essential to the success of the main harvest. Early yams are said to be ready for eating from the middle of June as a rule, but before *liboku* they can only be dug and brought into the village surreptitiously. From July onwards the women in their daily visits to the farms dig the early yams, as they are needed to feed the household until the main harvest begins in the last weeks of October.

This harvest is stored in great yam stacks built on all the farm paths 2 or 3 miles from the village. The stacks are made ready for the harvest by the men in October, while the yams which the men and women have dug together are carried by the women to the streams for washing and then to the stacks. Here they are laid out to dry in the sun for a week or two before the men tie them in the stack. When the yam stacks have been filled the cycle is complete and there is a short lull in farm work until the clearing for the next year begins.

Farm crops are not the sole vegetable products obtained through the year. Supplies of bananas, plantains, kola nuts, native pears (*Pachylobis edulis*), pawpaws, and coconuts are obtained from groves of planted trees laid out along the farming paths, round the yam stacks, and in the village. The tending of these trees is entirely in the hands of the men, about half of whom are also daily engaged in exploiting the outstanding wild food plant of the forest—the oil palm, from which both oil and sap-wine are obtained.

Problems and field methods

The rhythm of agricultural activities just outlined will be recognized as characteristic of many parts of the forest belt of the Guinea coast, and my object in this paper is not a detailed discussion of the technique of cultivation but a preliminary analysis of the organization of labour, and the consideration of that organization in relation to the resources of the territory and the production and distribution of the food supply and other wealth. In the course of my field work I made a census of the agricultural and other economic activities of about one hundred households, obtaining data on the composition of the household, the lands farmed, the crops grown, the division of labour, and the size of the harvest.

The effective study of the economic activities of primitive peoples demands more objective data than has hitherto been commonly obtained. Discussion of the efficiency of native methods and the limitations of physical conditions on the one hand, and of the relation between economic activities and social institutions on the other, cannot be securely based on general impressions or even on more detailed knowledge of a few individual cases, when such matters as division and intensity of labour, volume of production and accumulation and distribution of food supplies and materials are involved. But very real difficulties face the ethnographer here. He works alone in an area for which there has been no land survey, with maps, if any, that are only approximate and small scale, among people whose numbers have been only most roughly estimated if at all, and whose measures of time, value and area, are difficult to assess in objective terms. The people may be extremely suspicious of minute and systematic inquiries into their numbers, customary land rights, wealth,

and property, and may refuse or falsify information. Data approaching the scope and accuracy of those obtainable for a western country could only be secured with the aid of a considerable party of surveyors and investigators; and such a procedure might well defeat its own ends by arousing suspicion and hostility, which would frustrate any investigation of other related problems in which everything depended on the good will and confidence of informants.

Nevertheless it is often possible with resourceful use of the native standards of value and knowledge, and with approximate, even if unorthodox, methods of survey to achieve reasonably accurate estimates in the economic and demographic field. I therefore devoted some considerable time to attempts to work out and employ methods for assessing quantitatively the economic conditions and activities in Umor, which would be feasible with the co-operation of the people themselves and would yield in a relatively short period results adequate for ethnographic and statistical analysis.

Farm areas

The farm lands in Umor are held by adult men individually and a man of middle age will have established and recognized rights to half a dozen sets

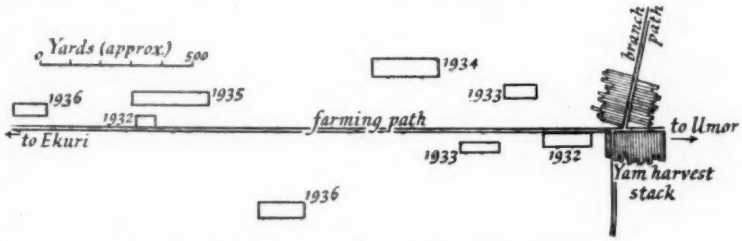


Fig. 4. Diagram of plots belonging to a single household

of plots (Fig. 4). Only one-fifth of the aggregate area is however cultivated in any one year while the rest remains in bush. One of my earliest tasks in Umor was that of finding a method of estimating with reasonable accuracy the size of these farm plots. Owing to the reluctance of their occupiers, the time required, and the difficulties of movement and sighting among the yam vines, it was impossible to make an instrumental survey of a sufficient number of farms to obtain adequate data on area and productivity. But the nature of the cultivation and the laying out of the farms in Umor permitted safe generalization as to the mean area and variation of farm areas. The process of clearing, hoeing, and planting farm lands proceeds piecemeal on each plot as the collective labour of a group of kinsmen becomes available to each individual in turn. A party of a dozen or so men clears a small stretch of bush day by day for each of their number in turn. These sections are hoed and planted by the women as they are cleared. The boundary between sections is marked and every man knows how many sections he has planted and the relative size of each. Further, the yam hills are made very methodically row by row across each section, forming an approximate rectangle (Fig. 5), and since the number of yam hills on two sides in each section could be readily

counted, an estimate of the number of hills could be quickly reached. The mean area of the individual farms of 97 adult able-bodied men of one patrilineal kin group (the Ndai kepun) obtained in this way was approximately $1\frac{1}{2}$ acres (1·40), the equivalent of 2440 yam hills. Thus a representative Umor household of a man, two wives, and three or four children is likely to have about 7 or 8 acres of farming land at its disposal, of which $1\frac{1}{2}$ acres are

Fig. 5. A tract of farming land. The figures on sides of sections show the number of yam hills counted

cultivated each year. The estimated aggregate area of farmland in Umor (a minimum of 18 square miles, of which 3·6 are actually under cultivation in a given year) is obtained by the application of these results to the total adult male population. The Ndai kin group consisted of five sub-groups or lineages of closer kinsmen in which the number of farm holders ranged from 16 to 27. The means for the farms of these component lineages lie fairly close to the general mean and some knowledge of conditions in other kin groups also indicated that a fair sample had been obtained. But the areas of individual

Ndai farms cultivated in 1935 ranged widely from 0·25 to 8 acres. Although only five of the 97 were 4 acres or more and only ten were less than 0·5 acres in area, there was a large group, about 40 per cent. of the total and not confined to the farms of young recently married men, which lay well below the average (between 0·5 and 1 acre in area).

The frequency distribution of farm areas is shown by the graph of yam hills in Fig. 6, in which the very high proportion of farms in the lower area classes is clear. This distribution, although it confirms a general impression that very small and very large farms were rare, is much more precise and striking than could otherwise have been obtained. The size of the farms of a

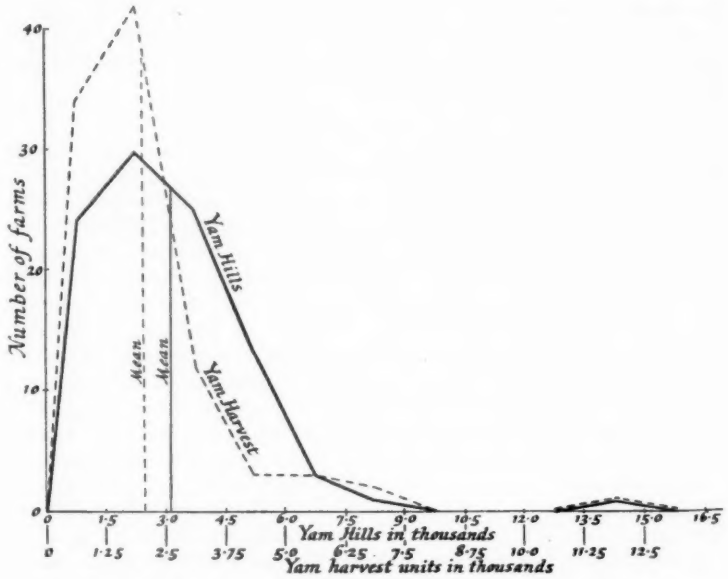


Fig. 6. Frequency distributions of yam hills and yam harvest

few individuals which appreciably raise the mean for the group was very surprising. There were five farms of 4 acres or more and they were in some cases disproportionate to the size of the household. The larger farms were, as in the case of the exceptional 8-acre farms, those which provided most of the surplus sold outside the village and contributed to the considerable Cross River trade in yams. The adult strength of a household farming unit will obviously set limits to the area which can be cultivated, but the area of farms was found to bear no simple relation to the size of the household whether considered as a farming unit of adults or a consuming unit including minors. Many other factors such as interest in trading and hunting, seed yams available for planting, the capacity of the man and women, and the services of kinsmen, all affect the farm area of individual households. The people

themselves are well aware of differences in farming capacity among both men and women. A youth is often told to choose as his wife a girl whose mother goes early to farm, while some of the elders often remarked that so-and-so did not care enough about seeing his yam stack grow bigger.

It is very significant, in view of the large stores of food that chiefs and leaders of social groups are said to accumulate among many peoples, that none of the very large farms in this kin group belonged to kin group leaders and priests or to heads of secret societies, who might be expected to have a special claim on the services of a wider circle of kinsmen or supporters. Indeed the priest and head of the Ndai kin group had a farm of only 1·2 acres, less than the average for the kepun as a whole, while that of his assistant was little above the average. It was clear from other instances that there is little tendency in Umor for men of prestige and authority to accumulate a large surplus of yams or other food supplies and marketable products, either by making large farms or by receiving gifts from others.

The size of harvest

At the end of the farming season I undertook a census of the yam harvest of the ninety-seven farms whose area I had estimated.[1] This was based on a native practice which lent itself to numerical estimation. At harvest-time the yams are stored in the stacks by tying them to raffia midribs or long stakes, each 10 or 12 feet high, set close together on the solid timber frame. The harvested yams, when they have been sunned, are graded according to size for greater ease in handling and are tied in neat, close-packed, vertical rows to the poles so that they form a solid wall of yams 8 to 10 feet high. Every person refers to his yam harvest by stating the number of upright sticks which he has tied with yams. Such an estimate may be rather misleading because the actual size of the harvest will vary according to the height of the sticks and the bulk of the yams. In addition to the large yam tubers a number of small yams, sometimes attached to the neck of the main growth, are formed, and these small yams, often little larger than a big potato, are used extensively for planting in the ensuing year. At the harvest of 1935 I found that the greater part of the larger yams were between 9 inches and 12 inches long and that very few exceeded 18 inches in length, while the small yamlets ranged from 2 to 6 inches in length. A closer estimate of the bulk of the harvest was made possible by counting the number of sticks in each of three sizes (under 6 inches, 6 to 12 inches, and over 12 inches), and by obtaining at each harvest stack a mean value for the number of yams on the sticks in each size group.[2] In terms of units of medium-sized yams the mean production for the 97 farms investigated was 2545. The individual harvests ranged from a single exceptionally low value of 235 to a maximum of 11,410 units of

[1] Data were actually obtained for 104 farm harvests, including those of six households for whose farms a count of yam hills could not be obtained.

[2] In the task of counting and recording the yam sticks, as well as in the earlier work of counting the yam hills along the sides of the farm sections, I was able to secure the untiring and very thorough help of an Umor man, Ubi Okoi. He was a member of the kin group which was the subject of my census and had returned to the village some years ago after a considerable period at a mission school. Speaking English and having an aptitude for figures which is by no means rare among West Africans, his help was invaluable when so short a time was at my disposal.

medium-sized yams, and the frequency distribution of the yam harvest is given in Fig. 6.

It will be observed that, while the harvest variation is of the same general character as that for farm area, an even larger percentage of farms falls in the lower class intervals, which suggests that a considerable number of farms above the average size do not yield a correspondingly large harvest. This is to be expected since yield will be considerably affected by care in cultivation, and the household data indicate that there are a considerable number of farms of more than average size with relatively low labour power as measured by the number of adult members. In such farms there would tend to be

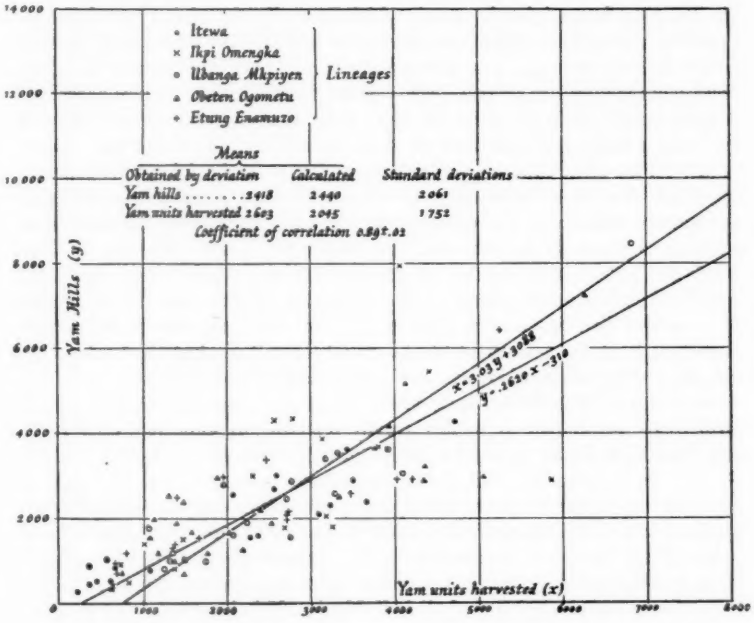


Fig. 7. Dot diagram of area and yam harvest of 97 farms in Ndai

some falling off in efficiency of cultivation. This cannot however be directly concluded from the graph and must be determined from a consideration of all the data concerning the households.

As the size of farms and the bulk of the harvest have been estimated independently, reliability of the estimates can be tested by investigating their correlation. Despite differences in fertility and in efficiency of cultivation, a high correlation between size of farm and bulk of harvest is to be expected for the series as a whole, and is shown by the data plotted in Fig. 7,[1] where

[1] I am indebted to Mr. G. H. Daniel for the construction of this diagram and for the statistical analysis based on it, and also for much help with the tedious preliminary calculations involved in assembling and checking the farm and harvest data.

the distribution of the dots indicates the degree of correlation. This has been calculated from the diagram as $0{\cdot}89 \pm 0{\cdot}02$ and is graphically indicated both by the narrow elliptical clustering of the dots and by the small angular distance between the regression lines for yam hills and harvest units respectively. The probable loss of efficiency in the cultivation of many larger farms is also suggested in this diagram by the downward sag of the dense dot cluster in the class intervals above the mean for yam hills.

Kinship basis of farmland rights

The farm and harvest data relate to one of the patrilineal kin groups in Umor through which individuals acquire rights to farmlands. Each patrilineal kin group or ***kepun*** (plural, *yepun*), which has collective rights to a delimited dwelling area in the village, has also rights to a number of tracts of farming land. The number and strength of the yepun in Umor cannot be stated definitely for there are several quasi-yepun which lack one or more characteristic features. From the point of view of farming rights there are about 30 kin groups ranging in size from 30 to nearly 200 adult men and their households. At the same time the yepun fall into larger territorial groups concerning which there is no clear theory of internal kinship. These larger groupings are wards (*yekpatu*) of the village, and it is on a ward basis that the village territory is primarily divided since the patrilineal kin groups of the different wards as a rule share a number of common farming paths. Fig. 1 shows the way in which the farming paths, and consequently the sectors of land reached by them, are distributed among the four wards. The people of the four wards thus farm lands lying in great blocks round the village; but the lands of the kin groups within a ward are as a rule considerably intermingled.

Large tracts of land, each a square mile or more in extent, lying along the farm roads are known by names usually referring to some natural feature, and their boundaries are known to all farming on these roads (see Fig. 5). But these named lands appear to be largely functionless and are no longer the basis on which land is shared among the yepun. The control of land by the men of a particular kin group is subject to slow but continual change by processes of piecemeal accumulation or abandonment. For each farm road used by a kepun there is a "farm path elder" (*oponotam eta*), who is expected to know the established rights of all individuals of his kepun on that road, to mediate in any disputes between those individuals, and to act as spokesman in disputes with other yepun. In general the majority of the men of a single lineage within a kepun farm on the same path—often in a cluster of contiguous plots in each year—and the path elder is often a leading member of the lineage which provides the majority of the kepun members farming from that path. He is thus a close kinsman of the majority of the kin group concerned.

The kinship basis of farm land tenure does not however completely circumscribe the farming rights of the individual. In the first place individuals or small groups of relatives are able, if welcomed, to migrate from their own kepun area in the village and go to live in the dwelling area of another kepun, and may, without formal adoption, be given farming sites in the lands of that kepun. A man may also obtain temporary rights to make a farm in the land of

another kin group. This is fairly often done where the man's own kepun is short of lands on the particular road he has elected to farm. He visits a path elder of another kepun (generally on the same path) which has a surplus and asks to be shown a tract which he may clear. A large gourd of palm wine must accompany such requests, when he visits the path elder in his house towards sundown. No other payment or gift is made for this right, but it can only be obtained by this formal recognition of the owning kepun's right and an appeal to its generosity. This is a very characteristic Yakö attitude. Few economic opportunities are bought and sold, but there is great emphasis on correct form of procedure, and on open recognition of favour.

If serious pressure develops on the farming land, new and permanent farming paths are opened. These are as a rule only shallow loops from the main path. Considerable labour is involved in opening up such paths and in keeping them clear of vegetation. Every year, as will be seen, large parties are formed to clear the farming paths at the opening of the new season, and despite the daily passage to and fro of people going to their farms a second clearing is often needed towards the end of the rainy season. Most of the old established paths have been used so long that the daily passage of human feet has worn a gully in the soft sandstone 5 or 6 feet below the level of the surrounding ground which may become a torrent after heavy rains.

A man first takes up farm land when he marries: that is, when he takes a permanent mate to live with him in an independent household. Before this he has helped his father and his prospective father-in-law. The provision of an elaborately coiled bundle of yam tying strings and a season's work in the farm is an important obligation of a youth to his father-in-law. In his first year of farming the youth usually receives a part of his father's farm land. If the father needs to replace part of the ceded land he, not the youth, goes to the path elder of his kepun to ask for and establish his claim to an unoccupied area.

In the first year the youth will probably farm only one or two sections of about one-quarter of an acre in total area. For the next two or three years he may continue to receive part of his father's farm plots as these are successively cleared for cultivation, while his father will as before recoup himself elsewhere if necessary; but after three or four years of farming he will endeavour to increase the area of his farm, both because there will by now with average harvests be a larger surplus of yams for planting in the coming year, and because he may already be taking a second wife. For his first year's farm the young man usually obtains his seed yams for planting from his parents, half a dozen sticks from his father and two or three from his mother. If his parents are poor or dead he will seek gifts from other close kinsmen. His wife will receive two or three sticks from her father and one or two from her mother, and she will get from her mother her supply of the early yams which belong entirely to women.

These two sources of planting yams—the man's and the wife's—are recognized as distinct, and the harvests they yield remain so throughout, for it is an important principle of Yakö farming that the husband and wife each have their own yams. Yams although they are the food staple play no part

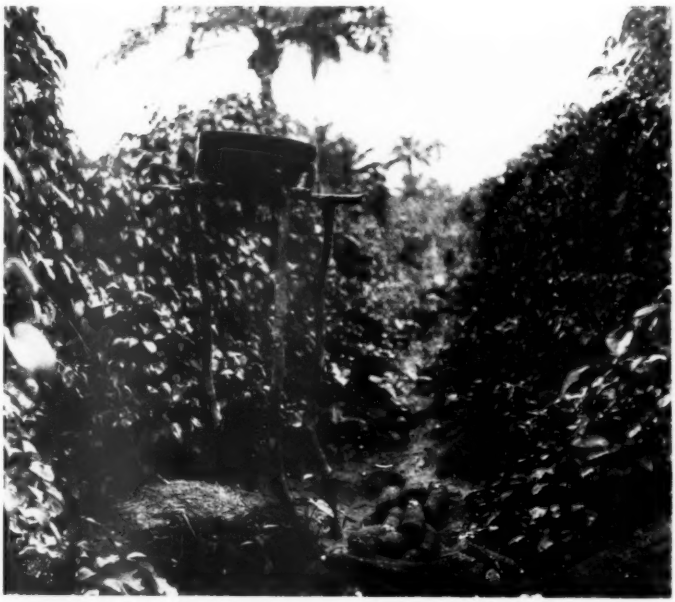
in marriage payments and both parties to the new household thus bring their own farming capital.

It is necessary to emphasize here that, while the division of farm tasks is applicable to the farm as a whole, the yams of the man and of his wives are planted and dug separately and are tied on distinct groups of sticks in the harvest stack. The husbands and wives have distinctive marks which they incise on the base of their yams as they are dug at harvest time and the yam harvest of both is used to maintain the family according to well-established rules. The husband's yams are usually completely dug, washed, and sunned first. He then proceeds to dig some yams for each of his wives every day that he is in the farm. During the period of digging, sunning, and tying, which lasts about two moons, food yams are taken from the husband's or the wives supplies according to whichever is being handled at the time. When the yams are being tied each wife also takes the equivalent of one stick, say thirty medium-sized yams, equally from her own and her husband's heaps. These are tied separately and are for food in the period immediately after the harvest, that is, from about the end of December, and when they are exhausted the wife is expected to use two sticks of her own yams for household food, before asking for a stick of yams from her husband. These four sticks of yams (120 or so medium-sized yams) are considered to be sufficient for the wife, her children, and her share of the food provided for her husband for two moons (late December to late February). By this time bush clearing for the new farm is well advanced, and before a wife asks her husband for another stick of his yams she should have begun to make yam hills on the first sections of the new farm. When this fifth stick is exhausted at the beginning of March, yam planting should have begun and the woman can then use the tips of the planting yams for food as well as the good parts of any decaying yams she may find on the sticks.

Hill making and planting generally occupy nearly two moons and after that, from late in April until the new yams may be dug in the latter part of July, the household must depend on a surplus of unplanted yams left in the stack. The area planted may therefore be limited by the minimum food requirements for these three moons, and inefficient cultivators find it hard to increase their farm areas on account of their very limited surplus after planting each year. In 1935 Ubi Okoi of Ndai, who had a farm of 2 acres with two wives, two young children, and one dependent relative (a youth who helped him in farm work and was fed by his senior wife), had tied 100 sticks of yams of his own at the previous harvest. His two wives had 40 and 16 sticks of harvest yams, a total of 156 sticks. Eighteen of these were used for food in January and February, 125 were used for planting and eating in March and April, and after planting he was left with eight sticks himself and his wives had three and two sticks for food until late July. Ubi gave four sticks to one wife, two to the other, and had two for feeding visitors during the three months before new yams were available.

While I heard nothing of serious famines among the Yakö and most households are able to keep an adequate, if not lavish, supply of yams for food in the period after planting, only a small minority regularly have a considerable surplus of yams. For these there is a ready market both in the village, among

A compound in Ndai



Yam hills during the growing season, with a pile of early yams in the foreground

Woman hoeing up yam hills

Man digging yams

those who need more yams for planting, and also in the riverside villages of the lower Cross River and at Calabar itself. It should be noted that a man can sell only his own yams, and a wife's surplus is similarly her own.

The early yams, which provide food for three months from mid-July are almost always the property of the women. A woman receives a small supply at marriage from her mother and she is entitled to plant them in every fifth row of hills in each section of the farm, including those sections that are otherwise planted with her husband's yams. From July to November about a fifth of the year's crop is thus removed from the farm. Although these early yams are normally the property of the women they are used to feed the entire house hold during this later part of the farming season.

Group labour in farm clearing

It is now necessary to review the farm cycle again and consider the special arrangement made for different phases of farm work. After the harvest of one year the farm roads and the narrow paths leading to the lands to be planted for next harvest have to be cleared. This is effected by compulsory co-operative labour. The path elders of the different kin groups farming on a road ask the heads to announce the day, and parties set out before daybreak working outwards from the village, cutting back the bush on the main road. When this has been done, smaller groups of men who propose to farm adjacent plots in different areas clear the branch paths giving access to their lands. Fines may be imposed on able-bodied men who refuse to co-operate, and one or two days is generally enough to complete the work.

The clearing of bush from prospective farm land is men's work, and it is also the occasion of co-operative labour. Farms are nearly always cleared and planted by stages in approximately rectangular sections, which vary according to the labour available from 200 or 300 up to 3000 square yards, although exceptionally large sections made only by older men with numerous sons and helpers may extend to over 5000 square yards. A party of a dozen men or more can clear a moderate section in a morning. Working parties are formed by the group labour of parties constituted within the yepun. Each man wanting a party to work on his farm goes to the kepun head bearing a calabash of palm wine and expresses his desire. This is generally done at an informal meeting in the compound of the kepun head or in the kepun assembly house at the opening of the farming season. All kepun members have an obligation to help for one day and they later go to the house of the applicant to make final arrangements. These kepun parties usually work only in the morning and on market, *i.e.* non-farming days, and the man whose farm is being cleared provides a midday meal of baked yams in the farm. The Yakö have a six-day week of which the second and fifth days are market and ceremonial days and the others are farming days. It is a general rule that services in public and co-operative work and other group activities should not be demanded on farming days, and most rituals, whether of the yepun, clubs or other groups, are generally confined to non-farming days.

The number of individuals taking part in the bush clearing groups, in the farms of one Ndai lineage alone, ranged from 5 to 50, but the number usually lay between 12 and 30. A man who intends to make a large farm of some 3 acres or more will need the services of four or more of these parties, but an attempt

at fair rotation is made by the kepun head and the path elders. Claimants can be called on to give their own services or those of their older sons to those who have helped them on an equal number of occasions. At farm clearing time there may be lively disputes as to priority in receiving parties and reciprocity of services. In practice strict reciprocity is not expected nor obtained, and as a rule it only becomes a point in debate when disputes arise on some other head. Kepun bush parties are usually enjoyed for their own sake, and since a minority of farms greatly exceed the average area there are always a few men who will need more help than can be required of them in turn. But if they offer a meal and a generous supply of palm wine, they will not as a rule lack helpers from among their kinsmen who have fewer yams. If a man requires more help than he can readily get from kepun parties, or if a man is at odds with his fellow kepun members concerning his rights and obligations either in the actual clearing or in connection with some quite different matter, and therefore refuses to take part in the kepun clearing parties, he has recourse to reciprocal parties of friends. These friends are as a rule farming a group of adjacent plots but are not necessarily members of the same kin group. Such a party generally numbers only about half a dozen men and successively clears sections of each member's farm, until the work is completed. Several instances occurred in Ndai of individuals who took little or no part in the kepun parties and relied on these parties of friends.

The clearing parties merely hack down the saplings and bush, and grub up the larger roots; the occupier often has to spend several farming days on a section of average size, digging out the mass of smaller roots and laying the land quite bare. Ten to fifteen days later he burns the dried vegetation which has been piled up in a number of heaps. Here again the services of a few helpers are needed, and men farming adjacent plots commonly help each other in starting and controlling the fires. Charred wood is cleared off and often carried back to the village, and the making of yam hills proceeds immediately after the ashes have been scattered over the section.

The hoeing of yam hills is traditionally women's work and in ordinary circumstances no Yakö men undertake it. But for nearly a generation now parties of "strangers" visit Umor at this time and share in this work as paid labourers. These foreign labourers are Ezza Ibos living west of the Cross River, among whom a considerably greater share of the farm labour is done by men. Parties of young men arrive at Umor in January and may stay for two months or more. They are hired by individuals, usually in parties of from five to thirty, and may work on one farm for from two to ten days.

Minor crops

After the yam planting—carried out jointly by the man and his wives in the intervals of clearing and hilling, and usually without help from outside the household—the farm work devolves almost entirely on the women. They plant between and on the sides of the yam hills the minor crops of maize, coco-yams, okra, pumpkins, and beans which are left entirely to their care. These minor crops afford welcome variety in a diet consisting so largely of yams. A capable wife is expected to be able to offer her husband dishes in which corn, okra, and other minor crops are used, and small supplies of most of these crops are stored—often in the house—after the harvest. On the other

hand the natives are aware that hills overloaded with minor plantings are likely to yield poorly in yams and fairly strict limits are set to this interculture.

From May to September the women work their way through the farm removing the weeds that rapidly spring up. The whole farm should be weeded twice and a third weeding is needed if a late ripening variety of bean, gathered a month or more after the yam harvest, is grown. Ground nuts, which are also valued as a relish, gourds whose fruit cases are used to make a variety of receptacles, and cassava, which is generally regarded as a foreign and insipid yam substitute, are however planted by men. Ground nuts often occupy a separate corner or the end of the last section of the yam farm and are planted in long wide ridges after the fashion of Hausa ground nut cultivation in Northern Nigeria.

Although the amounts grown are small most of these minor crops are raised on the majority of farms, and the following table of data from the Ndai farms shows that only cassava, the later ripening curly bean (*okpoma*), and the flat bean (*kekpomababali*), said to have been recently introduced, are absent from the majority of farms.

NUMBER AND PERCENTAGE OF NDAI FARMS GROWING MINOR CROPS

	Lineages						
	Ikpi Omengka	*Itewa*	*Etung Enamuzo*	*Obeten Ogometu*	*Ubana Mkpiyen*	*Ndai Total*	*% of Total*
Total Number of Farms	20	20	16	25	22	103	100
[1] Coco-yams	18	19	16	24	21	96	93·2
[1] Corn	19	20	16	25	22	102	99·0
[1] Pumpkins	19	18	13	24	22	96	93·2
[2] Gourds	18	4	5	18	14	59	57·3
[2] Cassava	3	5	10	3	4	25	24·3
[2] Ground nuts	18	19	11	25	22	95	92·2
[1] Okra	19	20	14	25	22	100	97·2
[1] Sword beans	16	11	12	22	20	81	78·7
[1] Curly beans	0	1	2	0	1	4	3·9
[1] Flat beans	0	0	2	0	0	2	1·9
[1] Sugar cane	5	10	12	4	6	37	35·9
[1] Peppers	19	19	15	18	22	93	90·3

[1] Grown by women.
[2] Grown by men.

Harvest labour

The labour involved at harvest in the digging, carrying, washing, and stacking of yams may be indicated by the actual numbers of yams tied in the stacks. In Ndai in 1935 the totals (for yams of all sizes) ranged from 350 in the case of a young man farming for the first time to 19,700, the harvest of an exceptionally large household from a farm of 8 acres. The mean was nearly 4000 per household and the average number of yams handled was over 2500 per acre of farm land.

Oil palms

While the farm plots are by far the most productive areas of the village territory and demand the greatest expenditure of labour, they are not the only economically productive areas. In addition to a wide variety of materials

for food and crafts collected on a small scale from the bush the products of the wild oil palm are obtained regularly in large quantities throughout the year. About half the able-bodied men of Umor are daily engaged in obtaining palm wine and palm fruits, while the fronds are also collected in large quantities for house roofing. The oil palm grows abundantly throughout the territory and is left standing when land is cleared for farming. Rights to oil palms are acquired through the patrilineal kin groups, each of which collectively claims the oil palms in tracts of territory reached from the farming paths. These tracts are not limited to the lands that are periodically farmed by the kin group but may extend into uncultivated areas, and there may apparently be considerable discrepancies between farming and oil palm rights. In detail the groups of palms actually exploited are constantly changing according to the yield and the convenience of their situation. Each man desires palms that are fairly easily accessible on his journeys to and from his farm, but side tracks have often to be kept open in the dense bush to reach them. Usually groups of two or three men co-operate to make a path into a promising and convenient area, settling their claims to particular palms by agreement.

A distinction is however recognized between palms tapped for wine and those from which fruit is collected. Palm wine—the fermented sap obtained by piercing the flower stalk and attaching a collecting calabash—has to be collected twice daily and considerable labour is involved in each tapping of an inflorescence which yields for only a month or so. To obtain about a gallon of palm wine some six to ten trees have to be climbed twice a day. Trees that are being tapped, have been prepared for tapping, or are being rested for three moons or so after tapping, are claimed by those who have worked on them and should not be interfered with by others. The owner generally places some leaves in a cut in the trunk near the ground to indicate that it is reserved to himself. An individual can however cut palm fruits anywhere in his kepun palm land so long as he does not interfere with the tapped palms of others. In practice most individuals collect fruits in a tract round their current tapping area, and since there is a surplus of fruits there are few disputes. Theft of accessible palm fruits by men of other yepun is however more frequent. Among 103 men of the Ndai Rui group, 50 were tapping palms for wine and 48 were collecting fruit. In nearly all cases part of the product was sold in the village.

Trade in palm oil and kernels

The preparation of palm oil is a household matter shared between men and wives. It is done at convenient intervals when a sufficient supply of fruits has been collected. Although the extraction of the oil is, apart from the pulping of the fruits, carried out by the wives, the oil, save for household requirements, belongs to the men alone. The wives receive as their share the nuts which they and the children crack to extract the kernels for sale.[1]

[1] The kernels are more valuable in trade than the oil, but they are shared among a greater number of women, since many men have two or more wives. In connection with the production of palm oil and kernels, which has increased enormously during the last generation and is by far the most important source of money income, there have grown up customs of division of labour and product as precise as those associated with farming.

Preparing the yam stack

A full yam stack

Tapping a palm inflorescence

Men pounding palm oil

The relatively small quantities of oil and kernels produced in the individual households are bought by one or other of the twenty or so men in the village who devote themselves to trading. Using kerosene tins with graduated dip-sticks to measure the amount of oil, the traders endeavour to adjust their payments to the prices they are likely to receive at Ediba or in Calabar. In Umor oil trading is regarded as a specialized and somewhat risky business, and very few oil traders have practically given up farming to devote all their time to the trade. When the traders think that the price offered at Ediba is too low they have their oil carried to Calabar, where they can offer it to a number of competing firms.

Since nearly half the men of Umor are producing palm oil, which is their only important source of money, the fluctuations in wholesale prices, which have been very great in recent years, have had a considerable effect on the purchasing power of trade goods and on the tax-paying ability of the people. Ediba prices for a kerosene tin of oil ranged from 1*s.* 1*d.* to 3*s.* 3*d.* in the twelve months from November 1934, and the highest price was of course far below that of the boom period. It is difficult to estimate the amount of palm oil exported from Umor, but nearly 200 tons of oil reach the Cross River from this region and Umor is likely to produce some 60 to 70 tons a year, which at 1935 prices would have a value of only £400 to £500.

Trade in palm kernels is a more widespread venture and a considerable number of the younger men engage in it. They often get their wives and older children to go about the village offering to purchase kernels by the handful. When a man has got together one or two bags [1] he takes them to the river for sale. About 1000 tons of kernels reach the Cross River from the Yakö villages every year, and of this the likely share of Umor, 400 or 500 tons, was worth about £2500. There are however more women selling kernels than men selling oil in Umor and probably two or three times as many kernel traders.

There are approximately 1500 households in Umor, so that their mean money income from the palm oil production of the village is probably slightly more than two pounds. This income is however very unequally distributed in the village.

External trade

The other forms of large scale external trade are concerned both with an entirely native product—smoked bush meat—and with European trade goods, particularly cloth and cutlery. It should be noted that as the one involves long journeys into the forests of Agoi to the east where game is abundant, and the other frequent visits to Calabar and Port Harcourt for European goods, this trading is more specialized and time consuming than that in palm products. Although oil traders occasionally buy cloth in Calabar for sale on their return to Umor this combination is not common, and the cloth and cutlery traders are for the most part young men who enjoy frequent visits to the coast and often return with a weird assortment of personal luxuries ranging from scented soap to cricket blazers !

[1] Jute salt bags which are the current native unit of measurement. In 1935 a bag of kernels was worth about 3*s.* 6*d.* at Ediba.

Hunting

A considerable number of Umor men hunt in the forest tracts and farm bush in the village territory. Game is taken in a variety of spring traps set along the paths and round the farms and is also shot with Dane guns—the long-barrelled flint locks that are widely used in Southern Nigeria. While a number of duiker and other forest buck and small game (of which the more common are lemurs, genets, civets, porcupine, and the Pangolin or scaly anteater) are obtained, this source of meat is very small in relation to the total population. Smoked bush meat brought in from Agoi is always available in the market, but the effective demand is apparently low, for only small quantities are usually displayed and it is only on the occasion of kin group and club feasts that it is seen in large quantities.

Livestock

Livestock do not contribute very substantially to the meat supply. The Southern Nigerian dwarf cattle are found in Umor but there were only 32 head of cattle in the possession of 103 men of Ndai in 1935, which suggests that the entire village stock is little more than 500, and some of this is sold every year to Ibos who visit Umor to obtain cattle for their title feasts. Goats are more than twice as numerous and are a common food at feasts, the excellence of which is judged by the amount of meat provided. There are practically no sheep, although neighbouring villages have them, and the pigs which foul some of the other Yakö settlements are not numerous in Umor. In fact the chickens and occasional ducks are the only animals that are at all common: there were on the average nearly two per household in Ndai kin group, and after five months it became increasingly difficult to satisfy the needs of a European menage! There is little doub therefore that the Yakö diet is decidedly defective in animal proteins, for meat is normally available only in minute quantities as a relish, and the local fish supply is negligible.

The economic activities of the 110 adult men of Ndai can now be conveniently summarized as follows:—

FARMING, TRADING, HUNTING, AND LIVESTOCK IN NDAI

Lineage	*Number of men*	*Farming*	*Old or idle*	*Trading entirely*	*Trading auxiliary*	*Hunting*	*Possessing livestock: cattle*	*goats*	*pigs*	*chickens*
Ikpi Omengka ..	21	20	0	1	3	5	5	10	7	14
Obeten Ogometu ..	28	26	2	0	4	7	4	9	0	19
Ubana Mkbiyen ..	26	23	3	0	3	1	0	12	1	18
Etung Enamuzo ..	16	16	0	0	1	2	4	2	0	9
Itewa ..	21	20	1	[no data]		1	3	6	3	9
Totals ..	112	105	6	1 (in 90)	11 (in 90)	16	16	39	11	69

TRADING IN NDAI

Adult men	*Total traders*	*Exclusive*	*Auxiliary*	*Oil*	*Kernels*	*Cloth, etc.*	*Bush meat, etc.*
112	14	1 [1]	13	2	5	1	4

[1] Bush meat, etc.

Land rights of matrilineal groups

The land rights and labour services so far considered all take their rise from the collective claims and activities of the patrilineal kin groups—the yepun—or their larger aggregations—the wards. But the patrilineal principle is not all pervading among the Yakö. There is also a matrilineal organization of great importance in village government and responsible for rituals of greater prestige than those performed at the yepun shrines. Furthermore, while individual claims to economic resources are usually established within the patrilineal kin group, the greater part of accumulated wealth and moveable property is inherited by matrilineal kinsmen. This practice controls among other things the disposal of the yam harvests of men and women when they die and may involve matrilineal relatives in obligations to supply labour in a farm to complete the cycle of cultivation of a deceased kinsman.

The economic rights of matrilineal kin groups may also, in certain circumstances, override those of the patrilineal groups, for the former lay certain claims to tracts of land which are at the same time cultivated and exploited by the yepun. At the funeral rites of an elder the dead man's matrilineal kinsmen can enter their tract and take wine from any or all of the tapped oil palms, despite the fact that these palms have been prepared by men who are not their kinsmen and who at all other times have exclusive rights to the palms, which they could defend in the village court. In these same tracts the valuable raffia palm may be planted in swampy ground by members of the matrilineal group, and these cannot be claimed either by the patrilineal kin group farming there or by patrilineal descendants of the planter. More recently the matrilineal groups have established a claim to the village share of the royalty fees which now have to be paid for felling within their lands certain valuable timber trees scheduled by the Forestry Department. As the patrilineal and matrilineal land rights coexist over the same territory and the boundary lines of the divisions do not coincide, there is an intricate dual mosaic of established rights to the resources of the village territory.

Although no farming rights or duties normally derive from the matrilineal kin organization, that system is nevertheless closely associated with the general prosperity of agriculture. Three great village rituals each year—the first planting rites, the "new yam feast" or *liboku* rites, and the harvest rites—are all performed by the priests at the fetishes of the matrilineal kin groups, and it is the response of these fetishes which is sought for the prosperity of cultivation.

Conclusion

Although the basic economic activities in Umor operate within a framework of established rights of kin groups, these are not simple or comprehensive in character. Farm land is acquired through the kepun, but the area of the farm and the co-operation of the kinsmen are subject to but slight group control, and the farm once planted is regarded as household property into which a fellow kepun member will not lightly enter lest his motives be misconstrued. There are great contrasts in farming prosperity among the individual members of a kin group, which are reflected in the ability of individuals to purchase membership in the village clubs. Similarly the establishment of rights to

bush products within the kepun lands is left to the initiative of individuals or small groups. At the same time specific but more restricted claims are made to the resources of the territory by kin groups of an entirely different order.

The kepun organization of farming activities involves some obligation of mutual assistance in path and bush clearing but little or none in other farming activities. In times of misfortune indeed it is to the matrilineal kin as often as to the kepun that the distressed individual or household turns. A man who through sickness or absence cannot attend to his farm is likely to ask a younger matrilineal kinsman for help in caring for his farm. The rights of matrilineal kin to inherit the greater part of a man's property are but a partial explanation of this attitude. The sentiment of *lejima* kinship, perhaps because it is not subject, owing to territorial dispersion, to the day to day rivalries and differences within the kepun, is surprisingly strong. Within the kepun there is marked individualism, and except on ceremonial occasions few effective demands can be made on the individual for the benefit of kepun fellows outside his lineage.

There is not at present in Umor any severe competition for land or forest products, for the village has adequate territory. The continuance of the great increase in population that can be inferred from village expansion in the last two generations may eventually result in land hunger if other sources of wealth are not developed; but assuming no basic change in the present economy, the population could probably increase by another 50 per cent. before severe strains would show. The need in Umor however, as so generally in Southern Nigeria, is not a further increase in density of population but modifications in economy which will improve the quality and variety of the food supply of the West African; a need from which arise the most important social and scientific problems of the country.

APPENDIX: SOILS

The natives of Umor recognize three different soils, distinguished by terms referring to their appearance, to which they attribute distinct agricultural qualities. The most widespread type in Umor territory is a light brown, very sandy soil known to the natives as *osodem*. It appears to have been weathered directly from the underlying bedrock of friable Cretaceous sandstone. The people themselves recognize its poor moisture-retaining qualities, for they say it can never be too wet for *osodem* and that in years when the rains, especially in the later part of the wet season, are unusually light the yams on it are small and the leaves of coco-yams wither. Chemical analysis showed a profile which, though strongly acid, had available phosphate well above the average for Nigerian soils, and also a carbon and nitrogen content high for tropical soil. There are also extensive but discontinuous tracts of a red clay known as *kesekpo* ("sticky red"). My informants generally agreed that this soil was harder to cultivate and did not in ordinary years yield such large yams as *osodem*. But they said they often got more yams from a single hill and so regarded it as more productive, especially in years of light rain. The soil proved to be a very heavy and extremely acid clay which was deficient in available phosphorus, but the carbon and nitrogen contents were rather higher than in the sandy soil. Finally small patches of black sticky soil, known as *keseblun* ("sticky black"), are found.

The *keseblun* is characteristically a thin surface layer a foot or less deep, although other thin horizons of the same character are often found within the much more sandy levels which occur below. The relatively small size of the areas of this soil—one patch was observed which extended for only 200 or 300 yards along a path—and their frequent occurrence in shallow depressions suggest that the black layers are mechanical accumulations of surface layers of soil washing. It is a soil much richer than the others in available phosphorus, carbon, and nitrogen, and contained free calcium carbonate. The indications are that it should prove very fertile but the natives regard it as more uncertain than *kesekpo* or *osodem*. When the rains are rather light and there is no concentration of heavy falls over a short period *keseblun*, they say, can yield the finest yams in Umor. But in years of heavy rain, and especially of rapid succession of severe downpours early in the rainy season, the yams grow poorly and often rot in the hills.

I was not able or competent to test the validity of the native views of the relative merits of these three soil types, but their assessment appears to correspond very well with the results of the chemical and mechanical analyses. It appears that the soils of Umor are of very fair fertility, as Southern Nigerian soils go. While they are inferior to the best soils in Yoruba country in the west, they are superior to the Benin sands and to most soils in the densely peopled Niger delta. But the physical differences between them are considerable, and it was very clear that the people themselves realized the importance of these physical contrasts between very light and very heavy clay, not only *per se* but also in relation to the character and amount of rainfall in different years.

Although men expressed different preferences for farming in *osodem* or *kesekpo*, there was not apparently any serious endeavour to secure farm plots in one or the other according to such preference; nor did any one with whom I talked about farm land suggest, or take interest in, the possibility of securing farm land for every year in each type of land to mitigate the respective risks of a very wet or an unusually dry season.

DISCUSSION

Before the paper the CHAIRMAN (Sir JOHN CHANCELLOR) said: I have great pleasure in introducing to you this afternoon Professor Daryll Forde, of University College, Aberystwyth, where he is Professor of Geography and Anthropology. Professor Forde was some time ago in America investigating the conditions of the Hopi Indians, particularly in regard to their mode of life as affected by their geographical position and surroundings. He has recently returned from the Cross River district in Southern Nigeria, where he went to conduct a similar investigation into the ways of life of the natives of that region.

Professor Daryll Forde's chief interests are in the geographical surroundings of people in relation to their mode of life and his main object in visiting the Cross River district was to investigate the primitive agricultural population living in the forest zone of Southern Nigeria. He is concerned chiefly with the relation of their economy to their physical environment and social organization. He chose the people of the Cross River because their method of life has not been affected by external influences and their mode of agriculture has not been seriously influenced by outside markets and modern opportunities for trade and improvement.

I have now great pleasure in calling upon Professor Daryll Forde to address you.

Professor Daryll Forde then read the paper printed above, and a discussion followed.

The CHAIRMAN: I would like, first, to call upon Sir Henry Galway. We shall appreciate comment by him.

Lieut.-Col. Sir HENRY GALWAY: I am not going to discuss yams, although I ate a great many of them during the fifteen years I served on the West Coast. I knew the Cross River first in 1895 and later when administering the Government of Southern Nigeria. The photographs brought the country back to me very vividly. The people have not improved in appearance, but they certainly wear more clothes than they did in my day! Perhaps coming into touch with Europeans has given them more modern ideas. I happened to go to Nigeria in 1891 with the first twelve officials, appointed by the Secretary of State for Foreign Affairs, to form the first Government. It was called the Oil Rivers Protectorate in those days, but nine years afterwards it was re-named Southern Nigeria and eventually called, as now, the Southern Province of Nigeria.

I remember well how the water in the Cross River rose during the rains. The Niger, every seventh year, probably rises no less than 60 feet in the rains, but in the Cross River the rise was more like 30 to 40 feet. The water came up fairly quickly as the rains were on, but when they were over it fell 10 feet and more in a night. I remember being up the river after the rains had just come to an end, when it was in flood. It had not begun to fall but we knew it was likely to. We retired for the night with our boat tied up on the level of a town, and when we woke up at 6 o'clock the next morning we were 15 feet down with the launch pulling at its forward hawser. We got out of the river as quickly as we could; we knew if we stayed another day we should have been grounded until the next rains. In those days we used launches drawing 4 to 5 feet of water. Now they use stern-wheelers which only draw about $2^1/_2$ feet or 2 feet of water and go up and down the Cross River at all times, rainy season and dry.

There is one matter which has nothing really to do with the lecturer's particular subject. I have been wondering how the leper establishment, set up eighteen months ago by Toc H at Itu, is getting on. Itu is the first town of any importance on the Cross River. The settlement is looked after by two young men who offered their services at a minimum salary amounting to something they can just live on. They are sacrificing themselves to benefit their more unfortunate fellow men, and I believe they have done wonders already.

Dr. WORTHINGTON: I should like to congratulate Professor Daryll Forde on the detailed study which he has outlined this afternoon. From the scientific point of view it seems to me that, as there are so few corners of the world left to explore, this is the kind of geography in which we in this country can really help advancement in other parts of the world. The detailed analysis of agricultural activities is much required for all purposes of economic and social progress in West Africa, and indeed in all other backward parts of the world, and the question is: who is going to undertake it? We might think it the job of colonial agricultural departments, but any one who understands the organization of an agricultural department must realize that such detailed field work is almost out of the question. The staff is of necessity so small that the few people with the requisite scientific knowledge and background have each of them to be in charge of a district, usually of many thousand square miles. It is impossible for them to settle down in one spot for six months or a year in order to make the type of analysis which Professor Forde has put before us. In fact it seems to be left to geographers and other scientists in this country to do the detailed work, of which I am sure full use will be made by those on the spot.

Professor Forde's attempt to turn what I suppose is a most inexact science,

namely agriculture, into a very exact one is particularly interesting, and there are certain questions I would like to ask. One is in relation to the ratio of cultivating years to rest or fallow years. It was pointed out that on the Cross River this ratio is 1 to 4, namely one year's cultivation to four years' complete rest. It is of course the effort of agriculturalists in Africa and in other parts of the world where shifting cultivation is practised to work on this ratio and to reduce it from 1 to 4 to 1 to 3, and then 1 to 2, and finally perhaps to introduce permanent cultivation. Does Professor Forde see any means of applying existing knowledge to a case of this kind, or does he consider any change unnecessary? Since a considerable part of the area seems to be permanent forest he might regard it as unnecessary to alter the existing system at all.

Another point I would like to query is whether there are any signs of the immigrant Ibo people he mentioned, who come and do sweated labour in clearing land, settling down to take up residence in this part of the country where there is no land hunger? The Ibo country, as Professor Forde mentioned, is one of those densely populated areas of Africa where definite land hunger already exists, where a population of well over 300 per square mile has not enough to eat or enough soil to work, and where soil erosion is making matters serious. If there is any possibility of immigrants settling down in these less densely populated parts, obviously it is going to assist future administration of the area in no small degree. One of the great problems of the Ibo country at the moment is where the surplus population is going to obtain a livelihood.

Finally I would like to endorse Professor Forde's concluding remarks that a main problem for these people in the future is to produce a greater variety rather than a greater quantity of their foodstuffs. We in this country enjoy a dietary so varied that limiting factors to growth and the maintenance of activity are comparatively rare, but the West African, for whom yams or millet provide practically the sole diet for months at a time, suffers so many limiting factors that his mental as well as his physical fitness may be impaired.

Professor DARYLL FORDE: I would like to assure Sir Henry Galway that even the stern-wheelers which are of very shallow draught are occasionally held up. I heard that some time before I visited the Cross River the Elder Dempster boat was left high and dry near Ediba for a whole season. The skipper tied up one night at the beginning of the dry season, the water dropped 8 feet by the morning, and there he was firmly stuck on the bank. He had to take a dug-out and go back to Calabar to report that he had left the boat behind!

We visited the Itu Leper Colony of the Scottish Mission which has developed greatly since it was started in 1928 on a sand-bank in the Cross River. The first site was washed out, but to-day there is a flourishing settlement of about 1500 people on high ground flanking the Cross River. Its internal economic system suggests that there is an interesting job for an ethnologist willing to work out the sociology of the community. It has its own plantations, crafts, and internal trade, and there is also trading with adjacent peoples. The lepers come from all over the eastern part of Southern Nigeria. New industries are growing up, and altogether it is a remarkable and exceedingly praiseworthy development.

With regard to the possibility of altering the ratio of cultivation and resting periods in this particular territory and east of the Cross River generally, there is to-day no urgent need for the production of more food from a smaller area. The people are not underfed in the sense that the volume of food is inadequate, but they are suffering, as people in this country are, from malnutrition. Malnutrition in the case of the Cross River people is due to a great lack in their territory of many of the food elements necessary to a balanced diet. The supply of proteins is the main difficulty and may always be so far as livestock are

concerned. More beans and legumes could be grown and fitted into the existing farm cycle, but the Yakö are not enthusiastic about beans because they mature so late and involve extra weeding, which the women would have to do within the annual cycle.

I take it that if the Yakö were subject to the same land hunger as the Ibo they would undoubtedly be compelled to cut down the rest period. The Yakö sandy soils are better than typical sand soils in the Ibo country on which there are densities up to 450 to the square mile. The cycle could be cut down by persuading the natives to clear their farms on a co-operative kin group basis, after taking a harvest out, and plant a manurial crop, returning to it after one year's rest. I think one could get the natives interested if they were handled sympathetically and some economic stimulus were given. If it could be started with one kin group and presented as a worth-while experiment it might be possible to get the whole village to adopt it. I would be willing to go and try with the help of an agriculturist.

The question of Ibo migration is very interesting. The British Government held up the eastward Ibo expansion at the Cross River. There are very few Ibos east of it. If the British Protectorate had not been established I expect that a territory possibly 20 miles deep east of the Cross River would now be Ibo country. But the Ibo advance which had been going on down to the time of the British occupation was arrested by the British administration of the area. The Ibos coming annually to Umor are mostly youths of seventeen or eighteen. They come to get money to buy cows and other materials required for marriage payments, and in some cases I believe, although I am not very fully informed, to pay for what are virtually rents for land. A system of leasing land has grown up in some Ibo areas, whereas among the Yakö and other semi-Bantu land rights derive by kinship from a collective holding group and there is no buying and selling of land. No agricultural Ibos live permanently among the Yakö, not because the latter would not admit them individually, but because the Ibo and Yakö are at almost opposite poles in Southern Nigerian social psychology. You cannot imagine an Ezza or an Ikwo, once he is adult, settling down to become a member of a Yakö community. On the other hand, individual Ibos do live among the Yakö as smiths, and a few sawyers, carpenters, and other craftsmen come in for short periods to do special work. Immigrant Ibos come temporarily, practising special crafts, but there is no permanent immigration or inter-marriage on any large scale at the present time. Nevertheless, there is a good deal of Ibo blood in the community, if one may misuse the word "blood," as is habitually done. Down to within the last ten years there has been a considerable accession of population in the Cross River villages by the adoption of children for whom money has been paid, and most of these children came from Ibo country and were brought by Ibo traffickers. It is generally referred to as slave trading, but there are no slaves in Umor or in the other Yakö villages. But there is a bump of philoprogenitiveness in the population which has been relatively wealthy, and households have been artificially increased by buying these children to enlarge the family and kin group. These children were and are adopted members of the household. The whole question is most important but it is too big to raise this afternoon. In that way an Ibo strain has come into the population, but it is biological, not cultural, Ibo, if Dr. Worthington will accept these terms.

The CHAIRMAN: I am sure we are most grateful to Professor Daryll Forde for his interesting lecture. He has given us a good deal to think about. One thought that arose in my mind in the course of his lecture was this. He told us he set out to the Cross River area as a place to go to because in that remote part

of the world, in a primitive agricultural population, he found a race of people who were untouched to an amazing degree by external trade. I imagine there are not many places where you would find a more isolated or more self-contained population than in the Cross River area ?

Professor FORDE: I think you would. The palm-oil trade gives a link or two.

The CHAIRMAN: Yes, that is my point. Even in that primitive community the palm-oil trade gives them a considerable volume of external trade. Professor Forde has told us that it brings them in about £2500 per annum which is available for the purchase of goods from abroad. That is very significant. Even that very primitive isolated people cannot do without external trade. If the rulers of certain great countries would pay attention to that fact they might learn something from primitive peoples as to the impossibility of any country being self contained; and a realization of that fact would do much to promote the peace of the world.

I ask you now to show your appreciation of the delightful lecture Professor Daryll Forde has given us.

THE EROSION SURFACES OF NORTH CORNWALL

W. G. V. BALCHIN

IT is generally accepted that past marine action has been a vital factor in shaping the present physiographical features of Cornwall. A study of the Padstow district in the light of recent knowledge concerning erosion surfaces suggests however that the exact importance of this factor has yet to be realized. So far little consideration has been given to the relation of the physiography to the already recognized platforms of marine abrasion, and their bearing on the cycle of river erosion. Thus the two upper platforms, the 1000 feet and 800 feet, have only been mentioned in connection with the associated stream tin and wolfram deposits,[1] and the 400-foot platform has received most attention in south-west Cornwall.[2] Apart from a passing suggestion by Wooldridge [3] of a possible extension of the 200-foot plateau of the London basin into Cornwall and South Wales, there appears to have been no mention of the existence of any further platform. The only basis for this extension is cartographic and would imply extensive eustatic or epeirogenetic movements for which there is at present little direct evidence. A detailed study of the district however suggests the presence of a further planation at a height of from 240–280 feet; this doubtless has hitherto escaped attention, either by virtue of its dissected nature, or because of a possible confusion with the 400-foot platform. It is questionable whether far-reaching correlation with exterior localities is possible with our present inadequate knowledge. The whole problem of erosion surfaces still seems to require a detailed regional approach.

The stratigraphical and structural basis [4]

The earliest formation met with is Lower Devonian, and during this period the Staddon grit sandstones were laid down in fairly shallow water. This deepened with the approach of the Middle Devonian period and the sandstone passed into slate. The coast-line at this stage lay north of the district and ran in an east–west direction. Southwards, where the sea deepened, finer muds and occasionally limestones were deposited. During this period eruptions from submarine fissure vents gave rise to extensive developments of pillow lava, and these, combined with minor oscillatory movements of the sea floor that occurred towards the end of the Devonian period, gave variety to the strata. In the north this has been intensified by dynamic metamorphism.

Post-Devonian history is largely conjectural because of the absence of deposits, but it appears that a Carboniferous subsidence followed upon a late Devonian continental period. Continued sedimentation occurred until the end of the Carboniferous period, when this region, in common with the greater part of southern Europe, was subjected to the Armorican earth movements. Granitic intrusions of the same time account for the Bodmin Moor laccolith

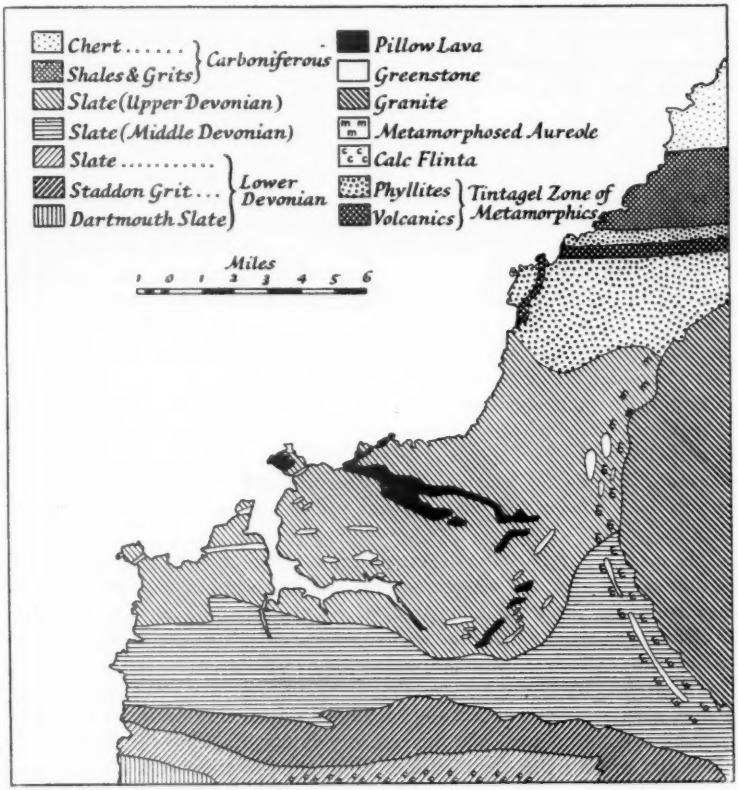
[1] Barrow, G., *Quart. Journal Geol. Soc.*, vol. 64, 1908.

[2] Reid, C., *Nature*, 1886, and 'Pliocene deposits of Britain,' 1890.

[3] Wooldridge, S. W., *Proc. Geol. Ass.*, vol. 39, 1928.

[4] Dewey, H., etc., Memoir to sheets 335 and 336 Geol. Survey, 1910. (Includes references up to 1910.) *Proc. Geol. Ass.*, 1914. *Q.J.G.S.*, vol. 72, 1916.

and the dynamic metamorphism which has altered the rocks in the north. It is from this period that the main structural trends can be traced; the Devonian strata were thrown into folds above which the Carboniferous rocks appear to have been formed into relatively high mountains. No further evidence exists until the Miocene, and it is probable that during the whole of this great length of time the agents of denudation were slowly removing the



Geological map of North Cornwall

mantle of Carboniferous rock. To-day Carboniferous rocks only remain in the north of the district, a general northerly dip bringing the older deposits to the surface south of Boscastle. The dominant strike of the Devonian rocks is east–west, but over most of the area this has been modified by several anticlines and synclines consequent upon the Armorican movements, whilst in the north the tongue from the Bodmin Moor laccolith, which metamorphosed the slates, has tilted the axes and in parts the strata to give a north-westerly strike. A strike line extending from Bossiney Bay to the middle of

Bodmin Moor marks the top of the Davidstow anticline, south of which is the St. Minver syncline in which the parishes of St. Tudy, St. Endellion, St. Kew, and St. Mabyn lie. In addition minor folds occur in the major folds enumerated above, and in the Tintagel district the former pass into overthrusts.

The Miocene period appears to have seen another submergence of the area, which initially can probably be related to the Alpine movements. The re-emergence was apparently characterized by fluctuations of sea-level alternating with periodic stillstands which created extensive platforms of marine abrasion. The present physiography has its origin, for the major part, in the dissection of these platforms.

The erosion surfaces

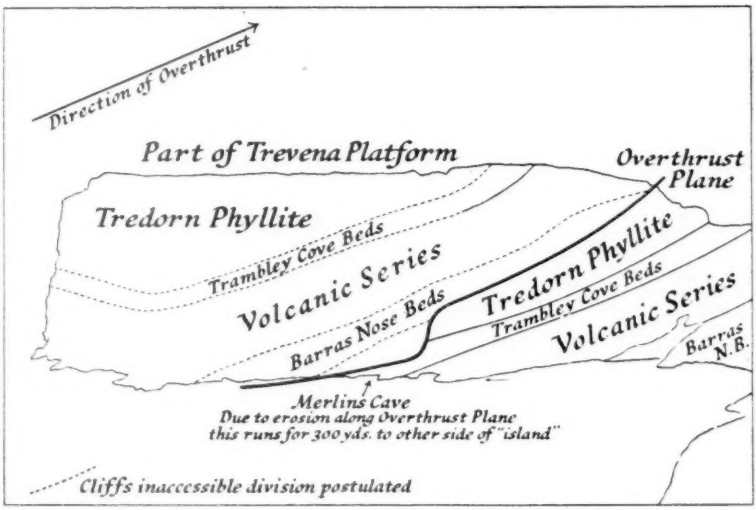
The feature rendering possible a separation of the erosion surfaces usually occurs in the form of a bluff or curve-over from a higher to a lower surface. Where this cannot be explained in terms of structural or stratigraphical factors a marine origin is suggested, for it is probably the remnant of an abandoned cliff-line, which implies a marine origin for the lower erosion surface. The platform slopes in a uniform gradient from the higher to the next lower bluff unless interfered with by river erosion; hence the height of the platform varies, and although a height reference is usual for platform designation it is obvious that a considerable displacement would expose a platform with a wide range of height. For purposes of correlation it is not the height of the platform which is required but rather the height of the sea-level of that period, a fact which is only deducible from fragments of the cliff-line related to the platform in question. The use of land heights for identification purposes is fallacious, and in the following account platforms will be referred to by names rather than by heights.

The map (Fig. 1) indicates the extent and distribution of the erosion surfaces as they exist to-day, and where a surface has been ascribed to marine erosion an attempt has been made by the help of physiographic and cartographic evidence to reconstruct the trend of the associated cliff-line immediately prior to the change which led to the exposure of the platform.

The uniformity of the Trevena (430 feet) cliff-line relative to modern sea-level is a well-established fact and suggests a further uniformity in the lower platforms; but at higher levels the certainty diminishes, for we are entering an older and much more denuded area in which cliff fragments are not well marked. But the heights of the fragmentary remains of the platforms considered in relation to their location, suggest that the district has not been tilted in the intervening period.

The Davidstow Platform.—Only a small fragment of this platform occurs in the area under consideration; it is more characteristic of Bodmin Moor, one of the best developments being south of Davidstow. The height of the platform is fairly consistent and is approximately 1000 feet above mean sea-level.[1] The origin of this erosion surface is by no means clear, for no fragmentary cliff-lines of a high definition occur, although certain features on

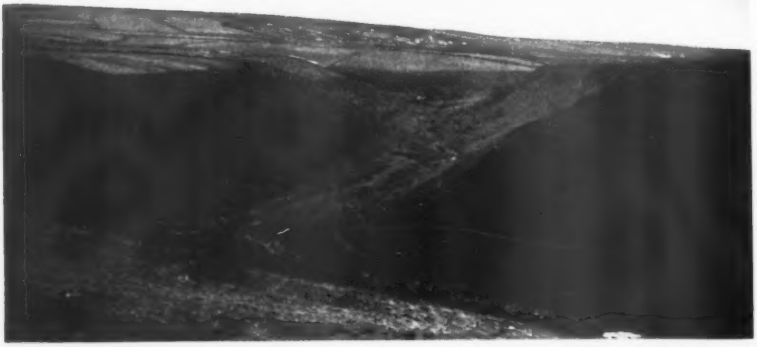
[1] Barrow, G., *Q.J.G.S.*, vol. 64, 1908.



1. Tintagel Island. The Trevena platform and the planation effected by marine erosion

2. Treswallock platform near Delabole, showing the Allen valley

3. Treswallock platform south of Camelford, showing Devil's Jump gorge



4. A tributary of the Backways valley cut in the Trevena platform

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Browngelly[1] Downs and Brownwilly Tor may possibly have such an origin. The manner in which the granite tors rise from the surface of the moor strongly suggests however that conditions in this area may once have resembled those prevailing in the Scilly Isles to-day; that is, the platform is probably of marine origin. The age is also uncertain as no associated deposits are known, but if mid-Tertiary folding be accepted as extending as far west as Cornwall,[2] it follows upon tectonic grounds that the platform is post-Alpine and hence probably late Miocene. On the other hand, if the influence of the folding did

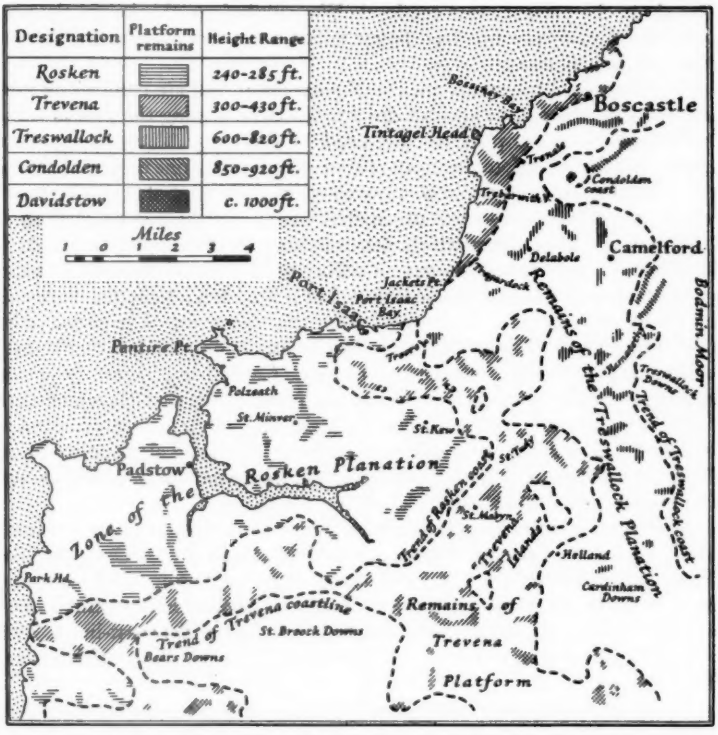


Fig. 1. Reconstructed coast-lines and platform remains

not extend so far west, it becomes impossible to set any definite limit of time for the formation of the platform.

The Condolden Phase.—In this case it is the cliff fragment which is conspicuous and not the platform. North of Delabole a ridge or bluff of some considerable extent is found near Condolden farm at a height of 920 feet (base) above mean sea-level. This feature, about 40 feet high, bears no relation to the surrounding geology and it is possible that it represents a minor still-

[1] Geological Survey memoir.

[2] Jones, O. T., Press Address Section C, Brit. Ass., 1930.

stand in the regression which led to the exposure of the Davidstow platform—assuming the latter to be of marine origin. The planated aspect of Waterpit Down from 900–850 feet suggests that this is a fragment of the erosion surface related to this bluff. Further fragments seem to be present east of Advent where they are preserved in the granite.

The Treswallock Platform.—The height of this platform has been variously given as 750 feet and 800 feet.[1] Actually it appears to have a considerable range of height, and although there is no conspicuous associated bluff, it is probable from Treswallock Downs that the related sea-level was some 820 feet above the present mean sea-level. Westwards from this height the platform drops to 650 or 600 feet, below which the curve-over to the Trevena platform usually occurs.

The individual fragments are not of great extent but are confined in most cases to hill tops and to parts of the interfluves separating the valleys which have been cut in the platform, *e.g.* south of Polrunny. The best exposures occur near Camelford, to the north of which there was at one time an extensive bay. A valley has been cut in this bay by the river Allen, but is only apparent when viewed in a north–south direction (Plate 2). Delabole is situated on an extension of the platform which also continues—but dropping in height at the same time—to the south-west. Looking south from Hamatethy a further great expanse of this platform is visible, but it has been intersected by several later valleys which are not revealed from this viewpoint. The preservation of this portion of the platform can be largely ascribed to the fact that it is cut entirely in granitic rock. To the south, around Cardinham, fragments become scanty as a rather complex river system has arisen on the mid-Devonian slate, and this has not only cut deeply into the platform but has in parts removed all traces of it as a result of lateral river erosion. The same also applies to the St. Breock district, but the upper parts of the watershed which runs east–west can probably be related to this planation.

Once again it is not possible to be conclusive about the age of the platform, but in view of the Condolden phase it is probable that it is post-Davidstow and hence later Miocene. In a region where geology appears to be of secondary importance in the physiography, it is of interest to note that it seems to have exerted its maximum influence in affecting the trend of the coast-lines. Thus the geology of the Treswallock period reflects the effect of the granitic mass of Bodmin Moor.

The Trevena Platform.—This platform and its cliff-line is the best preserved of all the erosion surfaces, and was the first to be recognized. The platform usually slopes westwards from 430 feet to 300 feet, differential marine erosion of the period having produced several auxiliary features. Thus in the area south of Boscastle the hard rocks of the metamorphic zone of the north faced the waves and seem to have retarded the eastward recession of the cliff-line; this in time led to the production of deep offshore water, the effect of which is seen to-day in a development of the platform at a height of 300 feet, whilst the slope up to the old cliff-line is more concave than elsewhere. Again the stillstand probably prevailed for some length of time, as the cliff produced appears to have been of considerable dimensions, the remnants now forming

[1] Barrow, G., *Q.J.G.S.*, vol. 64, 1908.

conspicuous elements in the physiography of the St. Breock and Trevena areas (Plate 4). One must not forget that preservation has occurred, largely because it is cut in the Staddon grit in the former area, and in the metamorphosed Palaeozoics in the latter.

The platform is best seen in the coastal fringe from Boscastle to Tregardock, and here is found the best development of deep V-shaped valleys, alternating with flat-topped interfluves, in the whole district (Plates 4, 5). The effect of this is well illustrated by Tintagel Island, an outlier of the Trevena platform; here a variety of rocks, which can be seen in section, have been planed down without reference to their varying hardness or structure (Plate 1).

South of Tregardock the unmetamorphosed rocks offer less resistance, so that the modern cliff has receded beyond the Trevena cliff-line; all traces of this cliff and its associated platform have disappeared. East of Port Gaverne however there is a sudden rise of the land unrelated to the underlying rocks, and it is probable that this marks a return of the Trevena cliff-line. South of Treore fragments of the platform are again met with, indicating that the coast-line of this period apparently changed direction somewhere in Port Isaac Bay. The remains in this district, whilst considerable, are somewhat fragmentary; and the presence of several minor islands, fragments south of St. Teath indicating that an elongated bay extended north, and an extensive trenching by the rivers, render difficult a reconstruction of the coast-line. In the same way the partial disappearance of the platform in the south can be ascribed to the work of the Camel and its tributaries, but significant fragments still remain south-west of Helland, at De Lank, and elsewhere. That at De Lank is of interest because a small stream now flows at the base of the old cliff, so that the "valley" has only one side.

Allowing for subsequent erosion, and by considering the area to the south of the map (Fig. 1), it is apparent that the St. Breock Downs area formed an extensive island during this period, its preservation following from the resistance of the Staddon grit. The latter, stretching from Bodmin Moor to the sea, forms a high ridge as far as Bears Down, west of which it is cut off by the bluff, and both hard grit and soft shale have been planed down to a level below 430 feet. From Padstow the bluff marking the coast-line is seen to form a conspicuous feature of the landscape to the south and south-east where it is cut in the Staddon grit.

Sands and beach pebbles have been found by the officers of the Geological Survey on the platform in the Newquay district and at Trenale near Tintagel, but as no fossils accompanied these deposits they are of little value for dating purposes. But from external evidence to be reviewed later it appears that the planation is of Pliocene origin.

The Rosken Platform.—In the Padstow district many of the hills are characterized by flat tops, and there is a marked accordance of summit levels. It is significant to note that the headlands from Port Isaacs to Park Head, which are composed of pillow lava and greenstone, are all truncated between 240 and 250 feet; this, and the carving of the hilltops out of hard greenstone, pillow lava and soft shale, suggests a common origin in marine planation (Plate 8). Inland the same is true for areas both in the softer slate and where dykes and sills come to the surface, but, as is to be expected, the hilltop heights

rise eastwards. This in itself indicates but little, since such a platform might conceivably be but a prolongation westwards of the Trevena platform, and although doubtless the Trevena phase was partly responsible for the incipient sculpturing, it is apparent from a consideration of the physiography that a further planation, as a result of yet another stillstand, can be recognized at a height of between 240 and 280 feet. This is also supported by evidence drawn from hypsographic and clinographic curves, and also by the nature of such valleys as those near Tintagel. The lower parts of these valleys assume sinuous courses, a feature particularly well marked in the Trebarwith valley; this is presumably a type of incised meander caused by rejuvenation following upon adjustment to the Rosken base-level.

The rise which separates the Rosken and Trevena platforms is not such an outstanding feature as those already mentioned, as the difference in sea-level between the two phases was not more than 145 feet; hence any cliff cut during the Rosken stillstand could not exceed this height, unless the coast receded into the Trevena platform. The height of the cliffing would diminish westwards from the Trevena cliff-line, and such differences would tend to be obliterated with the passage of time by denudation. On walking up the spurs or interfluves which separate the valleys in the platform, a sharp rise often succeeds a gentle gradient at about 285 feet, as in the neighbourhood of Port Isaacs, and such a rise where not related to the geology may possibly represent a fragment of the ancient sea cliff.

There are again no known deposits to help in elucidating the age of the platform, but the speculations already made about the higher platforms, and the physiographic features indicating a post-Trevena origin, suggest that it cannot be pre-Pliocene. Assuming that the dissecting valleys post-date the platform, a pre-glacial age is indicated, since many of these valleys are partly filled with head. A combination of these two aspects points to a late Pliocene age.

Hypsographic and Clinographic curves

The district has been divided into four sub-regions, and hypsographic [1] and clinographic [2] curves have been drawn for each, and also for the whole region (Figs. 2, 3, and 4). There is a marked agreement between the curves, and with certain reservations the various stillstands appear on all. The analysis for region D is interesting because it is difficult to distinguish any prominent breaks of slope on the clinograph which can be correlated with the hypsograph. The feature which emerges is the progressive decrease in the slope above 550 feet, implying a convexity in the land forms. This is borne out by the hypsograph, which approximates to a curve of the form $y=mx+c$ between B and C. Thus both hypsograph and clinograph indicate

[1] Wooldridge, S. W., *P.G.A.*, vol. 39, 1928. For this curve the area above a certain height, expressed as a percentage of the total area, is plotted against the height.

[2] Hanson-Lowe, J., *Geol. Mag.*, 1935. This curve is obtained by plotting the average gradient between successive contours. It indicates where marked breaks of slope occur. The accompanying clinographs are based on the formula $\frac{V\sqrt{\pi}}{(\sqrt{A}-\sqrt{a})\,5280}$, where V = vertical interval and A, a = area of land in square miles between successive contours.

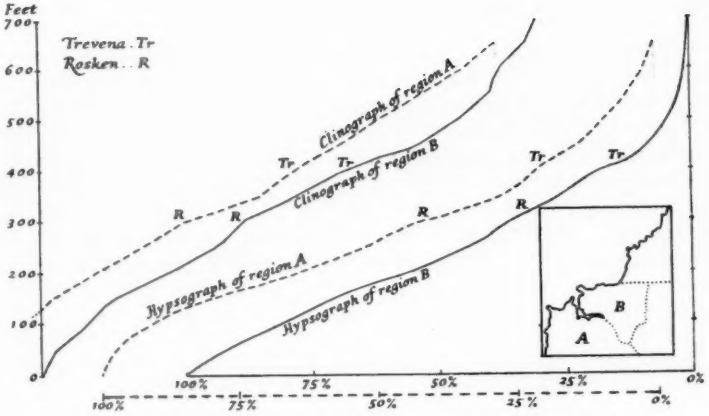


Fig. 2. Hypsographs and clinographs for regions A and B

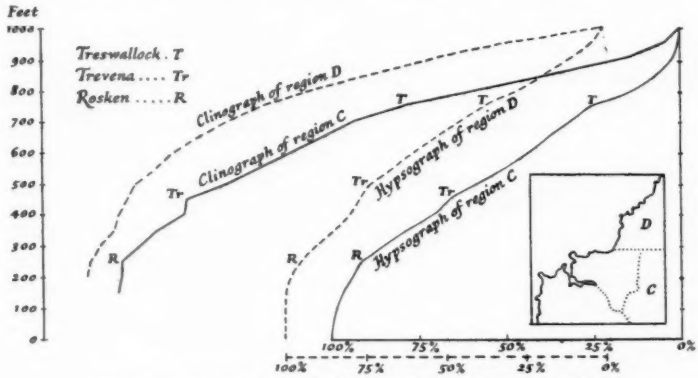


Fig. 3. Hypsographs and clinographs for regions C and D

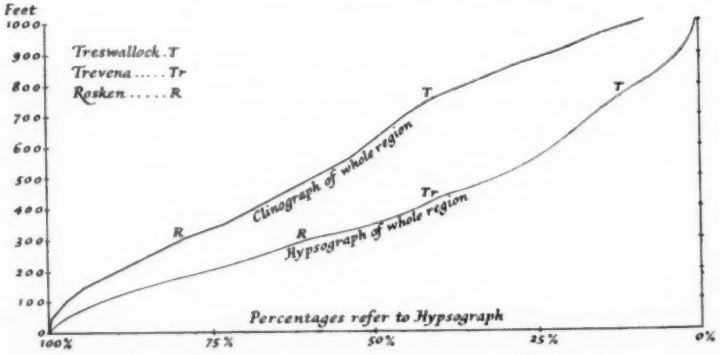


Fig. 4. Hypsograph and clinograph for the whole region

a paraboloidal land form. This occurs physiographically as the weathered down Trevena cliff-line which stretches from Boscastle to Jackets Point. A somewhat similar feature is to be seen in the graphs for region C. The verticality in all the hypsographs at low elevations is explained by the high coastal cliffs and deep V-shaped valleys which prevail. The curves for the whole region have been obtained by summation. It is peculiar however that the clinograph for this does not indicate the Trevena stillstand, which is the most conspicuous of all in the field. In addition, the general concavity of the hypsograph by no means approaches that usually connected with such curves

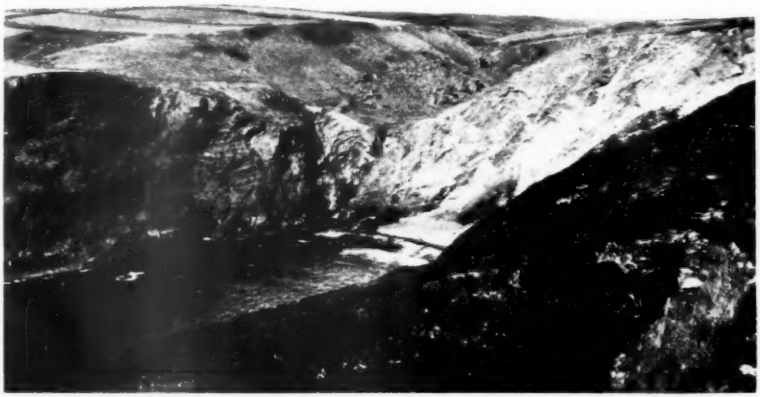
Conclusion

The region is of interest in that structural and lithological factors do not at present play a large part in the inland physiography, which is dominated by the platform sequence, and it is only where river erosion has been active that differences arise. Bodmin Moor itself cannot be regarded as a typical granite area from the physiographical point of view, for only the sounder granite illustrates the normal characteristics. Westwards, in the sedimentary district, rocks of igneous origin have mainly withstood denudation; pillow lava weathers into a type of hump-backed hill; elvan outcrops, for example in the neighbourhood of St. Kew, show up as long narrow ridges above the general ground-level; whilst dykes of proterobase have preserved such high areas as Helsbury Park; but in all these cases truncations occur at the platform level. Fragments of the platforms and of the associated cliff-lines can hence be seen to form an essential part of the landscape, and seem also to play a large part in the coastal physiography of the present day. Generally, the physical characters of the area can be summed up in the statement that it is a region of deep, narrow, V-shaped valleys, alternating with flat-topped interfluves which rise in step-like formation to the east.

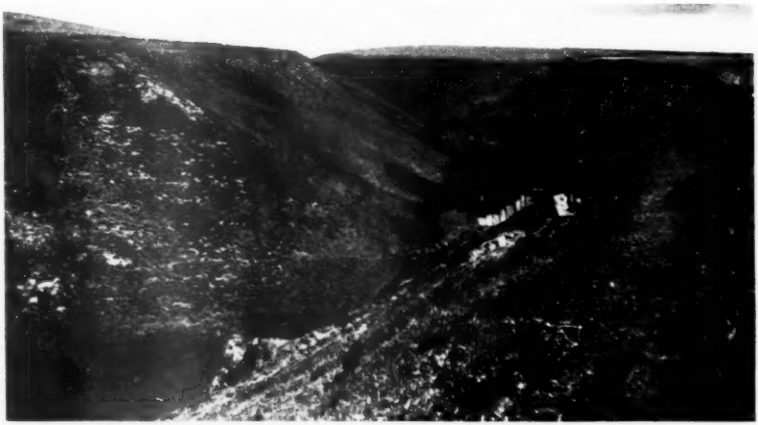
Such a generalization however must needs be misleading, for the area is rich in geomorphological problems awaiting solution. A major problem is that raised by a knowledge of the existence of the platforms, considered in relation to the theoretical basis of the graphical method of treatment. Thus the conclusions drawn from the hypsographic curve are based on the assumption that any land mass which is undergoing prolonged denudation tends to assume in any one part a curve of logarithmic or exponential form. By integration it follows that the region as a whole should exhibit such a characteristic. If this process is duplicated by the introduction of a new and lower base-level, it is clear that renewed erosion must affect the lower part of the curve as a new fluvial cycle is initiated. Thus each portion of the whole curve which forms a separate entity suggests the past existence of a major cycle, and each convexity suggests a stillstand and its associated platform. Curves will necessarily be difficult to decipher, for later cycles tend to sweep away earlier ones, and complications ensue as a result of the exposure of the platform—a marine and not a fluvial feature.

Despite these reservations, the agreement of the graphs, and the fact that west of each former coast-line all land lies below the height of the coast-line (apart from the Trevena islands), suggest that the region has been subject to

5. Trevena platform from Boscastle



6. Valley cut in the Trevena platform at the Pentargon



7. Jackets Point valley cut in the Trevena platform

8. Rosken planation from Lundy beach

9. Hog-backed Boscastle cliffs from the Pentargon

10. Vertical cliffs at Dennis Point

a prolonged negative movement. This was probably a result of a combination of eustatic and epeirogenetic movements, the change being punctuated by periodic stillstands during which the platforms were cut. The rivers on this hypothesis would be of an extended type, and the valleys would have been cut after the planations. A cartographic analysis of the river profiles will reveal numerous rejuvenation heads, and these can be easily explained on the above theory, but as the 50-foot contours on the 1-inch map are only interpolated, it is doubtful if such evidence can have much weight. True profiles are not obtainable from the 1-inch map. Owens [1] for example in levelling up the Valency valley noted a rejuvenation head at 180 feet, and this from the map appears at 150 feet. Only careful levelling of the thalweg can be conclusive. Hence little value can be placed upon any attempt to project river profiles, obtained cartographically, in order to derive former base-levels. The best evidence is from erosion forms produced by past marine activity.

There can be no doubt that in some cases the valley has been cut after the platform, for example the deep, clean-cut V-shaped valleys near Trebarwith (Plates 4, 7). But in many cases the platform-valley line of demarcation is not so clearly defined, and it is possible that the platform could post-date the valley. This applies more especially to the Trevena and post-Trevena planations, for in the higher platforms evidence from the physiography, the river valleys and examples of river capture, suggests that the valleys post-date the platforms in all instances.

On the other hand, that the alternative possibility must be kept in mind, is apparent when the Land's End district is considered. Physiographical and structural features, and the uniformity of the Trevena planation in both areas, suggest a very similar history; and in the Land's End region deposits of undoubted Pliocene age have been found at St. Erth resting *in* the valley. This can only mean that the valley was in existence prior to the transgression responsible for the deposits. These deposits have hitherto been related to the Trevena planation, but it has been seen that evidence from the Boscastle–Padstow district does not generally favour such a view, although not entirely contradicting it. Thus the course of the Camel has direct application to the problem, for it follows the Trevena coast-line for several miles before turning to follow the slope of the platform. It is difficult to imagine how this could have been achieved if a post-platform age is postulated for the origin of the valley, especially in view of the position of the island masses to the west. On the other hand, the Trevena appears to have been a prolonged period of planation, and yet if the valley antedates the platform in this area, why did so little erosion take place in the invaded valley, especially as the latter occurs in mid-Devonian slate ? Similar anomalies to this are found when the River Allen is considered in relation to the Rosken stillstand.

The height of the St. Erth deposits suggests a possible relation to the Rosken period, but this would mean an extensive land phase following upon the Trevena emergence, with the Rosken representing a subsequent resubmergence. There is a further possibility that the deposits may have resulted from a later Pliocene transgression, followed by a rapid regression, for which physiographic evidence is lacking. It is probable that the solution to this

[1] Owen, D. E., *Proc. Geol. Ass.*, 1934.

problem will be found if an analysis of river profiles obtained by means of levelling is made in conjunction with a study of the platforms for a small area.

Other interesting problems arise in connection with the hog-backed cliff feature [1] which characterizes a great part of the present coast (Plates 9, 10). Reid and Dewey [2] have suggested that it might be due to either a rounding off of a Pleistocene cliff under arctic conditions, or that it possibly represents a denuded later Pliocene feature. A consideration of the coast in this district however suggests that structure may afford an explanation, for this type of cliff appears to arise where the coast-line runs parallel to the strike, and where the dip is seawards. Where the coast-line cuts across the strike, vertical cliffs are common, as for example at Dennis Point; and where the dip is landwards, scarp conditions are found, as for example in the southern headland at Boscastle. On the other hand F. R. Gullick [3] thinks that a further stillstand occurred at 180 feet, and that the hog-backed feature is a remnant of the coast-line of this phase. But there appears to be no flattening out of the cliff in this district at 180 feet, which he maintains occasionally occurs on the Land's End coast. It is difficult to envisage the implied stability of the coast-line since the Pliocene period, if the hog-backed cliff be of Pliocene origin, especially as it is one of the most exposed coasts of the British Isles. In addition there is but one remnant of the pre-glacial raised beach at 10 feet in the district under examination, in Polzeath Bay. But in view of the conclusions reached by George [4] on the Gower coast, this aspect of the problem merits future attention. With it is closely connected the whole question of the relative importance of marine and sub-aerial forces of denudation, not only in relation to the hog-backed cliffs, but also to the succession of hanging, drowned, and normal valleys along the coast. Once again much help will doubtless be forthcoming from a consideration of carefully levelled river profiles.

F. R. Gullick [3] has also suggested the possibility of a further planation at 600 feet in the Land's End area, but there is apparently no physiographic evidence suggesting a separation of such a stage in the Padstow district, where any such planation appears to be a part of that associated with the Treswallock stillstand. This possibility cannot be dismissed so summarily however for the difference in level between the Treswallock and Trevena stillstands is considerable, and an intermediate stage is quite probable. Moreover it is significant that the clinograph for region B indicates a marked break of slope at 600 feet.

The chief conclusion to be drawn from the present study is the marine origin of the platforms. For this reason one cannot over-emphasize the importance of Cornwall as an area for the study of marine erosion surfaces considered in relation to fluvial cycles. The facility with which the heights of the sea-level of each planation can be determined is of great significance since these heights were once the controlling base-levels for fluvial erosion, and in a district which has suffered no glacial denudation, this information will be of importance when applied to levelled profiles. There is promise of con-

[1] Arber, 'The coast of North Devon,' 1912.
[2] Geological Survey memoir.
[3] Communicated.
[4] George, *Proc. Geol. Ass.*, 1932.

clusive results if this region and other similar localities in Cornwall could be subjected to a field analysis based on absolute measurements and treated mathematically. The problem of the inter-relation of the marine planations and fluvial cycles, coupled with that of the Pliocene sequence, could doubtless be unravelled, and this would also probably provide an explanation for the more immediate difficulties.

For these reasons, and because of the limitations placed upon the essay, the treatment necessarily becomes rather superficial; one can claim to have done little more than indicate the scope of the problem.

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The Council have awarded to this Essay the prize offered for an Essay of not more than 5000 *words: either a critical survey of recent additions to knowledge in a limited geographical field, or a discussion of some problem in its geographical aspect.*

The conditions of the competition for 1938 *were announced in the Journal for March* 1937, *p.* 291.

REVIEWS

EUROPE

THE LAND OF WALES. By EILUNED and PETER LEWIS. *London: B. T. Batsford*, 1937. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* viii + 120 *pages; illustrations and sketch-map. 7s 6d*

This book is well written, arranged, and illustrated. It is not, as at first it might appear to be, a guide-book mainly concerned with topography and scenery, but a history of the Welsh people, displaying their modern culture against the background of the past. The authors have been industrious, as is shown by their text and by the list of books used by them, among which we are surprised to find no mention of Dr. R. E. M. Wheeler's 'Prehistoric and Roman Wales.' For the Welsh, always devoted to the soil, who did not live in towns till comparatively recent times, country interests still, in spite of the growth of industrialism, make their life unique. Though living in isolation, they developed their characteristic activity of mind and enthusiasm. Farming, the keeping of sheep and store cattle, and the manufacture of woollen goods, reached its zenith in Tudor times. There is a vivid account of the life of cattle drovers who took their beasts by side roads from Wales to Essex, Kent, and Surrey, to Smithfield and Barnet. From 1600 to 1750 there was a slow reclamation of unenclosed areas by the squatter, who claimed by building a roof and chimney and kindling fire on the hearth by morning; before long the landlord claimed rent from him as tenant. About the latter date the new spirit of agriculture began to make itself felt, but quarrels arose between landlords and conservative Welsh farmers, and the prosperity of the Napoleonic wars was followed by a slump in 1816. The story of the town in Wales is the record of growth from isolated Norman castle to garrison town, and from that to civilian market-place. But even in this industrial era the country folk are happier for the intelligent craftsmanship of earlier days, of which the museum at Cardiff preserves an interesting record. They have remarkably preserved their language, their passion for singing and poetry, and their long memory for good and for evil. Possibly it is not easy for the rather suspect Englishman to assess the character of the Welsh, but to the reviewer the estimate given by the authors appears both penetrating and just. The illustrations, drawn from many acknowledged sources, are varied, and some of them are very beautiful. S. E. W.

FRANCE: A companion to French Studies. Edited by R. L. GRAEME RITCHIE. *London: Methuen & Co.*, 1937. $9 \times 5\frac{1}{2}$ *inches;* x + 514 *pages; map. 16s*

It is presumably the purpose of this series, while providing precise information, to stimulate thought rather than to furnish a catalogue of dates and facts; and in editing a companion to French studies the authors were of necessity compelled to ignore many aspects of French culture. The nature of the subject facilitated the exclusion of any consideration of mediaeval France. It has fallen to the Editor, in a preliminary chapter on "Country, people, civilization," to provide the brief beginnings as best he may. He regards France as fundamentally a Latin country, wherein the Frankish constituents have been fully absorbed, but he emphasizes the importance of a cultural concept of civilization in a land where its racial aspects are confusing and therefore (probably) regarded as of little account. Subsequent chapters by the Editor on the history of the seventeenth century and on the history and literature of the eighteenth century bring out the truth of this. Europe might dislike the hegemony of France, but

was not inimical to her culture. Professor Graeme Ritchie is evidently at home in the eighteenth century and Chapter VI is worthy of particular notice. The need for compression may account for occasional statements that read rather surprisingly. Is it certain that Charles II was secretly a Catholic in 1670 (p. 95)? The Peace of Utrecht is described (p. 143) as abandoning vast fields of enterprise to the English *and the Portuguese*. The chances of a more liberal monarchy under the Duc de Bourgogne and the Regent are discussed, and there is a careful appraisal of the character of Louis XV.

Probably the most outstanding of other contributions is "The philosophical background," by T. E. Jessop, which traces the course of French thought from the Renaissance down to Bergson and the Syndicalists.

The chapter on seventeenth-century literature is tedious, though that may be in part the fault of the period. The exclusion of mediaeval and renaissance France is more felt here than elsewhere. Dr. Sells tends to glorify Louis XIV; a useful corrective is provided later by Sir Reginald Blomfield in his chapter on French architecture (1494–1774), and by R. H. Wilenski, when he is dealing with French painters.

French history 1789–1914 is competently described by J. P. T. Bury, and the literature of the period is left to a chapter by L. A. Bisson, which too much resembles a catalogue. The twentieth century in literature has been worked out more successfully by Professor Boase, who gives an account of the main influences—Gide, Proust, Valéry, and Claudel—before treating of other writers in detail. Sisley Huddleston, on "Present day France," is inclined to be querulous and anti-parliamentary, but the balance is redressed by Professor Roe in a section on Parliament in his chapter on "French Institutions." Instability of ministries does not involve instability of policy. He deals as well with Local Government, the administration of Justice, and concludes with a very useful section on Education.

The book is properly indexed and provided with an adequate map. The attachment of a separate bibliography to each chapter (except for the chapter on Architecture, where the author is content with a passing reference to his own works) should not account for the lack of coordination. Date and place of publication are not always provided (in Chapter VIII both are omitted). The *A.* R. Curtius of Chapter I is presumably E. R. Curtius of Chapter II, where different details are given of his book. There is an English translation of Funck-Brentano's 'Le Moyen Age' (as of others of the series: see Chapter VII). In Chapters I, II, III, and V there is considerable confusion in the references to the works of Rambaud and Lavisse. Students for whom the book is intended will already be familiar with most of the standard works quoted in the bibliography to Chapter III. J. P. H. M.

WIRTSCHAFTS- UND VERKEHRSGEOGRAPHISCHER ATLAS VON POMMERN. Mit Unterstützung des Provinzialverbandes von Pommern herausgegeben von dem Geographischen Institut der Universität Greifswald. *Stettin: Ostsee-Verlag*, 1934. 14×12 *inches*. *RM.*15

This is a further addition to the list of European national and regional atlases, and is the product of some years of team work in the Geographical Institute of Greifswald University. It consists of some 130 maps printed on 56 double-page plates, based mainly on official statistics for 1928, which was chosen as a representative post-War year. The plates fall into three main sections: the first portraying the trade of Pomerania with the Baltic and the rest of Germany; the second, the distribution of population, arable land, forest, crops, animals, industries, etc.; the third, a miscellaneous group entitled, "The evolution of

Pomerania and boundary problems," and including historical maps as well as maps of the trade in certain commodities with the provinces to the south. Nearly all the maps are single-colour reproductions, because the University was desirous of publishing at a low price. In this regard it is to be congratulated on its sagacity. The price certainly gives value for money for a work of this character. The draughtsman also deserves praise, since in spite of this externally imposed limitation, he has achieved abundant clarity in practically every map. The present reviewer could find only two maps which, owing to their complexity, would have benefited by colour-printing—the soil map (which has 24 rulings) and the map of rural settlement types.

There is a valuable introductory essay on the economic geography of Pomerania, by the General Editor, Dr. Werner Witt. In effect he summarizes the broader conclusions to be drawn from the plates. Pomerania lies symmetrically astride the Oder estuary, and its single great city, Stettin, stands very close to the geometrical centre. Two of the North German glacial zones traverse the province (the Boulder Clay Coastal Plain and the Baltic Heights). Nevertheless, in soils and agriculture, the main contrast arises between the west and extreme south on one hand, and the lands around and to the east of the Oder Haff on the other hand. The former bear largely medium loams, the latter light loams or sands. Hence proportions of arable land, wheat and sugar beet are highest in the former districts, while rye and potatoes predominate in the latter, and there are extensive forests. In the west, too, there is more grass, probably a consequence of the more oceanic climate. It is also clear that the province is profoundly rural, and that *Junkerthum* is strongly entrenched. The isolation of Stettin, a great manufacturing centre and port, is most remarkable.

There is ground for satisfaction on the part of all concerned in this work. Without introducing cartographic novelties, and by utilizing well-tried dot, density, and other methods, a very good regional atlas has been produced which is likely to remain a standard reference work. J. H. G. L.

RICERCHE LIMNOLOGICHE SUGLI ALTI LAGHI ALPINI della Venezia Tridentina. Memoria N.10. Serie B. Ministero dell' Agricoltura e delle Foreste. R. Laboratorio Centrale di Idrobiologia .... Memorie scientifiche. *Roma*, 1936. $10\frac{1}{2} \times 7\frac{1}{2}$ *inches;* xiv + 564 *pages; illustrations and maps*

This volume is designed as an original contribution to the knowledge of the high alpine lakes of Venezia Tridentina, especially of those situated at a height of 1900–2000 m. above sea-level, this being the altimetric zone which includes the greater number of the lake basins of the Italian Alps. The various aspects of the subject are carefully tabulated and more or less fully discussed. A bibliography of five closely printed pages on the physical characters of these lakes and another of eight pages on their biological features indicate the zeal with which the study has been pursued during the last fifty years by Austrian, Swiss, and Italian investigators.

In 1931 the lakes of Venezia Tridentina were chosen for special study by the Italian Association for the Advancement of Science, and the organization and direction of their exploration was entrusted to Dr. G. B. Trener. Various expeditions were made during the years 1931–34 to the northern and central Alps, especially to the porphyry chain of Lagorai and the dolomitic group of Sella. Altogether there are about 511 lakes and tarns in Venezia Tridentina, about half of them being included in the altimetric zone of 2000–2500 m. The majority of the lakes occur in areas of crystalline rocks. The present volume is

the first contribution to the study of the whole area, and deals mainly with the districts of Lagorai and Merano.

The chain of Lagorai is a curving cuesta inclined towards the north and formed by a sill of quartz porphyry intrusive into a group of quartzose phyllites. The southern front is scalloped by cirques and obsequent valleys. The northern slope has developed its own hydrographical system, and several of the consequent streams have coalesced to form the Lagorai River, a tributary of the Avisio. In the valley there is one large lake, Lago Lagorai at 1868 m., and three lakelets at 2360 m. near the crest of the escarpment. The valley is of the staircase type, with bars of rock forming the risers and alluvial flats, probably infilled lakes, forming the treads. Lake Lagorai occurs on the fourth tread and the lakelets on the sixth. In Dr. Trener's terminology it occupies a valley cirque and the lakelets mountain cirques. In popular language the lakes may be said to be of glacial origin, since their basins have been modelled by snow and ice. Their primary origin however is probably to be referred to the superposition of glacial conditions upon a pre-existing topography which is at present very imperfectly known. In the same way the staircase valley, though modelled by ice, had an obscure pre-glacial history which has not yet been unravelled. There is no doubt that this is the correct philosophical attitude to adopt. Numerous references are given to the work of French, German, British, and American geographers, including the important paper by Professor Garwood on "Features of Alpine scenery due to glacial protection" (*Geogr. J.* 36 (1910) pp. 310–39).

The second group of lakes studied comprises those of the high valley of Sopranes in the district of Merano in the central Alps. Here also the rocks are crystalline but more varied in composition and structure than those of Lagorai. The lakes occupy valley cirques whose erratic distribution is at present inexplicable, but possibly dependent upon peculiarities of the pre- and inter-glacial topography. Lago Lungo (2382 m.), with an area of 17·3 hectares, is the largest of the lakes in the Val di Sopranes, and likewise the largest of the high alpine lakes of Venezia Tridentina above 2000 m. It contains two basins with maximum depths of 22·5 m. and 35·5 m. respectively, separated by a bar or undulation of the floor not more than 9 m. beneath the surface. Altogether eleven lakes have been investigated, and all of them are rock-basins except the Lago Azzurro (3050 m.) in the Val del Tell, which is a glacier lake. All the lakes are partially infilled with morainic material, coarse detritus and alluvium. None of them compares in depth with the high mountain lakes of the French Pyrenees at corresponding altitudes (*Geogr. J.*, August 1936, p. 170), and the problem of their origin is thus less intricate. Lago Verde (2338 m.) with an area of 3·6 hectares and a depth of 26·8 m., presents some approximation to the problem. Perhaps when the work is more advanced it may be possible for the investigators to make a detailed comparison of the morphological features of the lake basins of the Italian Alps with those of the Swiss and Austrian Alps, the Pyrenees, and other high mountain ranges.

More than half of the memoir is devoted to the meteorology and hydrology of the lakes, to the thermal, optical, and chemical properties of the waters and to the biological and bacteriological features of several of the basins. Many interesting points are raised and discussed and the investigations appear to be very complete. One misses however any reference to the economic possibilities of the lakes, but this may perhaps be reserved for a future publication.

It is to be hoped that these researches will be continued and that other groups of lakes in the Italian Alps will be explored in due course. J. D. F.

MEDITERRANEAN MAGIC. By ELEANOR ELSNER. *London: Herbert Jenkins*, 1937. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 256 [including xii] *pages; illustrations.* 8*s* 6*d*

Mrs. Elsner's wanderings in the Mediterranean begin at Crete. Thence she proceeds to Constantinople, the "harridan of cities," before turning westwards to Sicily and Corsica. In these earlier pages she justifies her title: there are passages that seem directly inspired by the magic of the eastern Mediterranean. After Corsica, and the description of Bonifacio, the author gives way too much to her love of story telling. The digressions range from a description of a typhoon in the China seas to a disquisition on true love which, forgetful perhaps of the *improbae Gaditanae*, she puts into the mouth of a sea captain of Cadiz. The final chapters deal with the Basque lands. Here the enchantment of the Mediterranean is missing, and it seems as though the yacht's party, overshadowed perhaps by the return to England, dwindles to the status of well-bred but ordinary tourists, chiefly interested in food and salmon-fishing.

There are a large number of misspellings, not all attributable to the printers. Marshal Lyautey's name might have been given correctly. J. P. H. M.

THE PROBLEM OF WINELAND. By HALLDÓR HERMANSSON. (Islandica, Vol. XXV.) *Ithaca (N.Y.): Cornell University Library. London: Humphrey Milford*, 1936. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* 84 *pages.* 5*s*

The briefest study of the literature concerning the Norse discoveries of America is enough to convince the student that its interpretation presents many problems. General agreement exists only on the essential fact that the Norsemen visited, and therefore discovered, the north-eastern coasts of America. In the course of time scholars and amateurs have studied the evidence from the Icelandic Sagas; recently these sources have been used for political propaganda. It is therefore opportune that the latest issue of the series "Islandica" should summarize the present knowledge of the Wineland voyages and assess critically the value of the relevant passages in the Sagas. Professor Hermansson is a scholar who has spent a lifetime in the study of Icelandic literature, and this thesis bears the mark of authority.

Sagas in the course of centuries do not merely become gradually modified and less accurate. Incidents and whole blocks may be absorbed from other tales; and there is a tendency to symbolize events, so that while the general shape is preserved, the roles are given to different personages and the narrative simplified. The sources on the question of Wineland are really only two: the *Saga of Erik the Red* from the Hauksbok and the *Tale of the Greenlanders* from the Flatey Book. The latter is the more recent version. It exists, not as a continuous narrative, but in a compilation describing the lives of four kings. It differs considerably from the *Saga of Erik the Red*, and the problem is to decide which of these two accounts to accept as material from which to attempt an elucidation of the actual voyages. Some authorities, in particular Mr. G. M. Gathorne-Hardy, have claimed the Flatey version as superior. Professor Hermansson follows Professor Storm in a downright rejection of the *Tale*, comparing it on the basis of textual criticism not with the best Sagas, but with the Mythical-Heroic and even the Lying Sagas. The incidents it contains are either nonsensical or garbled accounts, misplaced in sequence, of other voyages in Erik the Red's saga. The *Saga* represents the tradition preserved by the descendants of Karlsefni, a great man and the real explorer of America; the *Tale*, on the other hand, is a tradition debased and garbled after several centuries' circulation amongst the people.

The author discusses shortly the alleged Norse remains on the American continent, of which none can be accepted as genuine. He then interprets the

actual courses steered, after describing the several hypotheses which have been put forward. Both Leif's route and that of Karlsefni were inside Newfoundland, across the Gulf of St. Lawrence; Wineland was on the coast between Cape Cod and Nova Scotia. Helluland and Markland were both on the coast of Labrador, north and south of Hamilton Inlet respectively.

The tradition seems certainly to have been lost before Columbus' journey. In any case there is no conclusive written evidence that the explorers of the fifteenth century were aware of the geographical discoveries of the Norsemen of the tenth and eleventh centuries. It is worth noting that Professor Hermansson approves of the application of the name Hvitserkr to the highest summit of the Watkins Range in East Greenland. M. A. S.

KING ZOG'S ALBANIA. By J. SWIRE. *London: Robert Hale and Co.*, 1937. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 302 (*incl.* xiv) *pages; illustrations and map.* 12*s* 6*d*

Albanians have some reason to feel grateful to the author of this book. Their country, though within three days' reach of London, remains, from circumstances beyond their control, one of the least known in Europe. The Turks, its masters until the Balkan wars of 1912–13, had no interest in developing a province which to their eastward-looking eyes lay on the road to nowhere, and since their liberation poverty has hampered the Albanians in their attempts to make good the neglect of centuries. They have however introduced enough improvements to feel ready for visitors and are anxious to attract them. Nothing could better serve their purpose than this book, especially as it is based on several years' residence in Tirana, five or six excursions, and considerable reading of the works of earlier travellers. Page after page describes the steep blue mountains of the country, its green, softly rounded hills, its brightly tinted plains, its magnificent cloud and atmospheric effects, the picturesque costumes and old-world ways of its peasant inhabitants, and the hospitable welcome offered the foreigner by government and people. Thirty photographs, some unusually good, supplement the pen pictures. A jagged line on the map emphasizes the abrupt way in which the mountains up and down the length of the country rise steeply from little more than sea-level to several thousand feet. Frequently the author gives the historical background; if Skanderbeg, the national hero, remains wooden, the fault probably lies with the scantiness of the information available, for Ali Pasha of Tepelen lives and breathes as we read. Mr. Swire commands a flowing style, a full and rich vocabulary, and the knack of the happy phrase. He contrives to write in the first person without egotism, and tells the story of his expulsion from Albania without rancour.

Descriptive passages and historical summaries apart, Mr. Swire is not a safe guide to things Albanian. When repeating his charges against the people in power which caused his expulsion, he does not mention their supreme merit. On their advent to power in the King's wake they found Albania divided within itself, and they helped the King to give it a unity and a public spirit unknown in all its previous history. Princess Senije is not the eldest, but the third, sister of King Zog, and Shevqet Bey Verlaci is not a political refugee in Italy but was returned at the head of the poll in Elbasan at the recent parliamentary elections. Mr. Swire also writes Peshkepijë for Pishkopi, Yssuf for Isuf, Amet (the King's personal name) for Ahmed. He states that Albanians use the definite or indefinite forms of names "as the mood takes them," whereas they follow rigid rules. A *kulë* to him is a house built for defence, but to Albanians a two-storied house, defensible or not. The name Gjinokaster comes, not from his mythical Gjin Bua Spata, but from the Greek Argyrocastro (silver, *i.e.* white, castle) as the local pronunciation "Gjirokastër" plainly says. Town Albanians are not

anthropologically different from the highlanders, and the Turkish element in the population except at Svetigrad (Koxhaxhik) is negligible. Like an early nineteenth-century traveller, Mr. Swire constantly says Turk when he means Muhammadan, and he is obsessed by the word "oriental"; few adjectives could be less appropriate to the high-spirited, nervy Albanians, and the "oriental lethargy" for which he chides them is mainly malarial. A woman's blood, far from being "of no account," is priced in a vendetta at exactly half the value of a man's. M. M. H.

ASIA

GÉOGRAPHIE HUMAINE DE LA SYRIE CENTRALE. By RICHARD THOUMIN. *Paris: Ernest Leroux*, 1936. 11½×8 *inches;* viii+362 *pages; illustrations and maps*

France has no reason to reproach herself so far as the scientific exploration of Syria is concerned: her archaeologists, geologists, and geographers have worked hard, as is shown by M. Thoumin. He is an officer of the French Army, who has spent many years in Syria, and his book is a thesis for a doctorate, undertaken under the supervision of Professor Blanchard.

Central Syria, with which he is concerned, represents only a part of the French Mandate surrounding the two capitals, Beirut and Damascus, and comprising Lebanon, Anti-Lebanon, Hermon and El Beqa'. Within such limits the author is able to treat his subject in great detail: plans are given of every village and the mode of life therein, of every type of house, and of every scheme of irrigation. The accumulation of detail is apt to become wearying: it is a book to consult rather than to read.

The author does not furnish the comparisons with similar countries which would be desirable. A precise description is given (p. 168) of the traditional methods by which the Syrians turn their abundant apricots into preserves; North Africa, equally rich in apricots, has not passed beyond the stage of drying them. This is but one of many examples of the manner in which less civilized Morocco lags behind ancient Syria: a development in which the author is not interested.

Certain general ideas are however rather confusedly or timidly suggested. Beirut, the leading port in Syria, is linked with Damascus across the heights of Lebanon by a mountain railway incapable of carrying heavy traffic. Like other railways in Syria, it goes back to the Turkish epoch. A government desirous of developing the country would obviously make Tripoli the port and railhead. M. Thoumin has something to say in favour of Tripoli, and hopes that the situation may be modified by the pipe-line from Mosul, but he does not envisage the deliberate substitution of Tripoli for Beirut. His aim is simply to describe the situation as it is, and not to give a critical picture of what it might be. Central Syria, as he describes it, is an ancient country which the Mandatory Power has not seriously tried to change.

Although the author does not say so, the reader might infer that the Mandatory Power was open to criticism. Extenuating circumstances however can be pleaded, as has been made clear by René Tresse in "L'Irrigation dans la Ghouta de Damas" (*Revue des études islamiques*, 1929). In the oasis of Damascus, by far the most important in Syria, the system of irrigation goes back to the time of the Omayyads, and would gain by being modernized. M. Tresse has demonstrated the difficulties: the complication of rights and the dead weight of tradition. To remove such obstacles the energy of a dictator is needed; and a mandate is not a dictatorship. Under the mandatory régime, Syria has been

left to herself at a moment when she was exposed to European and world influences after the war.

The best pages of M. Thoumin's book deal with road traffic and with emigration. The disorderly and excessive increase in the number of cars bears no real relationship to the needs of the country. Emigration to every part of the world has taken the best from Syria and demoralized the population. Syria under the mandate, abandoned to her instinctive reactions in the face of the modern world, threatens to produce anything but prosperity and moral stability.

E. F. G.

ROAD THROUGH KURDISTAN: The narrative of an engineer in Iraq. By A. M. HAMILTON. *London: Faber and Faber*, 1937. 8×5 *inches;* 332 *pages; illustrations and maps.* 12*s* 6*d*

The Ruwandiz road runs from Arbil in northern 'Iraq through the Kurdistan mountains to the Iranian frontier near Rayat, traversing on the way the magnificent gorge of Ruwandiz and the Berserina gorge, and is approximately 100 miles in length. It was constructed by the 'Iraq Public Works Department during the last four years of the British Mandate between 1928 and 1932, partly as a civilizing project to bring peace to the wild mountainous country of Kurdistan, and partly for commercial reasons to provide a new route for trade between north Iran, particularly the Tabriz district, and 'Iraq. The Shah of Iran, appreciating its value to his country, agreed to extend the road from the Iranian frontier round the east side of Lake Urmia to Tabriz. The road therefore provides Tehran with a new way of access from the Mediterranean.

Mr. Hamilton is a New Zealander who joined the 'Iraq Public Works Department in January 1928. He was first appointed as Engineer in Charge of the Diwaniyah district south of the Euphrates, and in the first three chapters of his book he gives an interesting account of the difficulties of administration in that troublesome area and of the serious floods of 1928. About midsummer in the same year Mr. Hamilton was transferred to Kurdistan and put in charge of the Ruwandiz road, and the rest of the book describes his four years of arduous work on that project. It is a well-written description of work accomplished under great difficulties. Starting with a minimum of equipment and with mostly untrained men, with no European to assist him, the author was entirely responsible for the organization and carrying out of all phases of the operations, and for avoiding friction between his polyglot road gangs and the local tribesmen. He has a genuine interest in the people and has many stories to tell of the local chieftains, of Shaikh Mahmud and the Kurdish struggle for independence.

The book is well illustrated by 28 photographs, and has two maps adequate for following the text. There is no index.

N. L. F.

THE PAGEANT OF PERSIA: A record of travel by motor in Persia, with an account of its ancient and modern ways. By HENRY FILMER. *London: Kegan Paul, Trench, Trubner & Co.*, 1937. 9½×6 *inches;* 422 (including xxiv) *pages; illustrations and route-map.* 15*s*

Mr. Filmer is an American who went to Iran, apparently in 1935, with "vague notions of its geography, its history, its politics, and its culture," and toured all the principal towns by motor. Afterwards he made an intensive study of the literature and wrote this digest of the history, religions, and customs of the country superimposed on the impressions of his journeys. The author's method is to retravel his own route, describing the historical associations of the districts, towns, and monuments encountered on the way. The Gulf region was only

touched at Mohammerah. The book is well written except for occasional lapses, and forms a useful summary of Iranian history for the intending traveller. As a record of travel and personal observation it is necessarily superficial. The two concluding chapters deal with modern history: Chapter XI on "Modern Persian history in the light of Anglo-Russian rivalry," and Chapter XII on "The march of modernism in Persia." The latter gives a good account of the reforms introduced by Reza Shah and of the gradual breaking of the power of the mullahs. Economic matters are in general outside the scope of the book. There are some minor inaccuracies. It is hardly correct to write of "the tropical vegetation of the South" (p. 30); the Khurramabad–Salehabad road follows the river Kashgan and not the river Diz (p. 43); the figure given for the 1931 oil royalty is misleading (p. 57); there are no artesian water wells south of Ahwaz (p. 59); it is an exaggeration to say that "the unclean foreigner is seldom seen in Khurramabad" (p. 43), and that "few are the European travellers who have ventured to proceed to places so isolated as Yezd and Kerman" (p. 123).

The book is illustrated by seventy-four photographs of variable quality (many of them would be improved by being trimmed to the vertical; one of a Tak-i-Bostan bas-relief is upside down). Inside both covers is a rough route-map, which is erroneous in showing a passable motor road from Chahbahar to Bampur. There is a full index and a good classified bibliography. N. L. F.

DURCH PERSIENS WÜSTEN: Neue Wanderungen in den Trockenräumen Innerirans. By ALFONS GABRIEL. *Stuttgart: Strecker und Schröder*, 1935. 10×6½ *inches;* xvi+272 *pages; illustrations and maps.* [*M.*16]

Dr. Gabriel is an experienced and exceedingly conscientious traveller who, driven by the urge of instinct to wander in the waste places of the earth, turns his obsession to good purpose by making it a vehicle for the acquisition of scientific knowledge. In 1928 he made his way from Bandar 'Abbas to Bam, visiting the Jaz Murian *en route*, and thence by devious paths along the margins of and across the Lut to Tehran, a journey described in 'Im weltfernen Orient' (1929). The present volume records an itinerary in the opposite direction. The author left Tehran on 1 March 1933, and left Iran in December of that year at Duzdab on the border of Baluchistan. His interest is focussed particularly on the salty expanses of the Great Kavir and the sandy wastes of the Southern Lut; but the narrative provides a vivid picture of the whole of this most unattractive region. The style is simple and clear, but highly flavoured with poetry and romance. B. K. N. W.

DEPARTED GLORY: The deserted cities of India. By Arthur R. Slater. *London: The Epworth Press*, 1937. 9×5½ *inches;* 128 *pages; illustrations.* 5*s*

The idea of including in a single volume a series of short sketches of the more notable among the ancient cities of India, so many of which, even in their ruins, preserve remains of great historical or archaeological interest or architectural beauty, has much to commend it. Ample material now exists in reports of officers of the Archaeological Department and in the local gazetteers for the preparation of such a work. With the exception perhaps of Bassein, Mr. Slater has made a suitable selection of twenty representative sites. His descriptions, illustrated by sixteen good photographs of striking architectural or sculptural features, and amplified in some cases by quotations from travellers who had visited the cities while they still retained much of their old splendour, disclose a broad outlook and appreciation of the vicissitudes through which so many of them passed. It seems a pity that the text should not have been scrutinized by some one conversant with Indian history and conditions, as many errors

might thus have been avoided. Apart from cases of spelling and interpretation of Indian terms that call for revision, the following mistakes should be corrected in any fresh edition. Mohenjo-daro cannot be assigned to "the Buddhist period," as the ruins there date from some two millennia before the time of the Buddha. Hsüan-tsang did not visit Taxila "in 400 A.D." (p. 17), but in the seventh century. Queen Elizabeth sent no embassy to Jahangir (p. 32), who ascended the throne after her death; the reference here seems to be to Terry, who became chaplain to Sir Thomas Roe, the ambassador sent by James I. Terry, so far as we know, did not himself visit Chitor; his information about it was probably obtained from Roe. Alau 'd-din sacked Chitor in 1303, not 1290 (p. 34); Bahadur Shah (not Bazazat) invested the fortress in 1534, not 1537 (p. 35); and "Labri Khan" was not a deserter from the fleet of Vasco da Gama, as Tod suggested as a possibility (see Whiteway's 'Rise of the Portuguese power in India,' p. 183). The iron pillar at the Qutb, near Delhi, commemorates a ruler named Chandra, not Dhava (p. 55), which was an old and incorrect reading. The first capture of Deogiri fort by the Muhammadans took place, not in 1335 (p. 64), but in 1294. The Afghan ruler of Bihar (by whom presumably Sher Shah is meant), who sacked Gaur, did not make Pandua the capital (p. 77). Tipu Sultan of Mysore was not in power in 1722 (p. 104): he reigned from 1782 to 1799. C. E. A. W. O.

A PAGEANT OF ASIA: A study of three civilizations. By KENNETH SAUNDERS. *London: Humphrey Milford*, 1934. 9×5½ *inches;* xii+452 *pages; illustrations.* 21*s*

Professor Saunders is convinced that "it is time to put Asia 'on the map' of Western Schools and Colleges;" hence this "pageant of Asia." One is inclined to quarrel with the title, because it conveys the impression of a unitary civilization existing as in Europe, whereas the pageant is an historical study of three very different cultural developments in India, China, and Japan. No direct attention is given to the Persian or Arabian part of the picture, nor to Babylon or Assyria, nor to the medley of races and composite peoples in Central Asia, including Huns and Turks, which have been an important factor in the history of Eurasia. It is therefore as a triology of historical studies that 'A Pageant of Asia' commends itself to the reader. It is an able book, for the author has a genius for getting detail into a picture which he is painting on a very broad scale; and this detail is of the kind which the intelligent but ignorant European particularly requires from the interpreter of alien civilizations. Professor Saunders has the scholar's eye for the formative works of the period he is examining. Every chapter contains a wealth of quotation and ends with several pages of "illustrative readings." As a method of popular historical writing this is highly to be commended. It brings the reader close to the actual authorities and at the same time does not interrupt the flow of the narrative. Further, the author is not afraid of bombarding the European mind with endless foreign names and terms. He has followed a courageous policy, and it is proof of his art that we are not bemused by these exotic words which we cannot pronounce, but derive from them a sense of the reality of the story and the people described.

Limitations of space prevent the separate appraisement of each part of the book. In this description of culture in process of development Professor Saunders has done justice to the element of war which has figured so largely in the life of these great communities. His doing so is the more commendable because his interest is in the mystical, and he has a strong sense of the universality which makes the mystic of any particular time and race a proper study for men of all races and ages. By giving us the background of war, of imperial or feudal

struggle, he enables us to see more clearly the essentially religious reaction of what Voltaire called "the crowd of innocent and peaceable men" who "are always invisible upon this vast theatre" of history. An alien religion and its art becomes for us much more than a corpse exposed to view. In dealing with the spread of Buddhism from India to China and then to Korea and Japan Dr. Saunders is able to use his special knowledge of Indian Buddhism to excellent account, thus making possible an appreciation of each race's particular reaction to Buddhist experience.

In Part II on China there are a considerable number of mistakes in detail. The author does not claim to be a Chinese scholar, and pays his debt of recognition to the Chinese students who helped him in California and to the scholars with whom he conversed in China. His difficulty here has been the wide variety of historical outlook to be found in the present generation of Chinese scholars and students. Professor Saunders has obviously gone to the critical historians, but he has also drawn from conservative sources, and at certain points has come to conclusions which no school could allow. It is definitely misleading to speak of Motse, the philosopher of the fifth century B.C., as "something of an anarchist" (p. 237) and as "a Confucianist disgusted by the very ceremonies which delighted his master" (p. 236). As a political theorist Motse was never an anarchist. He visualized a State like Plato's Republic with the best men governing, and the common people modelling every opinion on that of their superiors. Confucius was in no sense Motse's master. With regard to the author's treatment of the Confucian Canon (p. 265), the *Ta Hsüeh* (not Hsieh) was not "compiled in the Han era from the Book of Rites," but was one of the constituent parts of the Book of Rites, a Han compilation. And we must protest against the use of the term "Four Books" as existing from Han times. It was the Sung age (twelfth and thirteenth centuries) which first spoke of the "Four Books," and of the four *Mencius* was not even in the Canon until that time. It is to be regretted that there is no statement as to the growth of the Canon during the ages between the Han and Sung periods.

The book is illustrated with some very fine plates. Dr. Saunders has gone far afield for these, and has made admirable selective use of the vast stores of material to be found. There is a chronological table giving concurrent events in Malaysia, India, Ceylon, Corea, and Japan; and an index. E. R. H.

TERRITOIRES ET POPULATIONS DES CONFINS DU YUNNAN. Traduit du Chinois par J. SIGURET. *Peiping: Henri Vetch*, 1937. 10×7 *inches;* x+308 *pages; maps.* 12 *dollars chinois* (*abroad* 16*s*)

The book contains prefaces and six essays by Chinese authors of some authority. Descriptive accounts are given of racial and territorial questions in the regions to the east of the Burma–Yunnan frontier, and their countrymen are taken to task for their apathy and lack of interest in this remote corner of China where, the authors complain, the predatory British have been nibbling off bits contiguous to Burma. As a matter of fact, Yunnan public opinion has long entertained a lively suspicion of the administrative adjustments which the Burma Government has occasionally undertaken among the uncivilized tribes on the Burma side of the border. There is an abundance of Chinese literature dealing with the various tribespeople, but much of it is admittedly fanciful and inaccurate.

The present work was published in Chinese in 1933 at Yunnanfu by the Education Office, with the approval and assistance of the provincial authorities. E. C. W.

AFRICA

THE EARTH GODDESS: A study of native farming on the West African coast. By G. HOWARD JONES. (Royal Empire Society Imperial Studies, No. 1212. General Editor: A. P. NEWTON.) *London: Longmans, Green and Co.*, 1936. 9×5½ *inches;* viii+206 *pages; illustrations.* 12*s* 6*d*

The British territories in the Guinea coastlands of West Africa are, thanks in part to the evil reputation of its climate, among the few tropical regions in which an important production of exported agricultural raw materials has been achieved without large capital outlay, close control of development by Europeans, or wholesale disruption of the native economy. Some of the commercial difficulties of West African agriculture, defects of quality and difficulties of standardization in particular, are no doubt largely attributable to this grafting of cash-crop production on subsistence agriculture in tribal communities, but the accumulation of internal stresses which often embitters the social and economic situation elsewhere has so far been avoided. Economic and social conditions are however far from static, and a clear long-term policy of agricultural development is urgently needed if full use is to be made of natural resources and if the evils of social disintegration are to be avoided.

Mr. Howard Jones's book, written after five years' service in the Agriculture Departments of Nigeria and Sierra Leone, is a broad survey of the present position and the possibilities for the future. It is a very personal study, in both its quick sympathy with the people and its informality of style and treatment. It is not a technical analysis of specific problems but rather a consideration of the wider issues of West African economy ranging widely in space and time for significant analogies and suggestions.

Mr. Howard Jones emphasizes at the outset that agriculture is not merely a means of livelihood, but a way of life; a fugue, as he styles it, with technical (or scientific), economic, and social themes whose developments may begin independently but inevitably react on each other. These themes have been very differently developed in different cultures, and he is at pains to show, in sketches of agricultural systems in medieval Europe and elsewhere, that agricultural efficiency is not merely a question of scale of farming. In West Africa the maintenance of household economy, small growers farming for food and exportable cash crops, has mitigated the impact of European demands and influence which has so often undermined social stability elsewhere. Technically however the agriculture has serious defects, and Mr. Howard Jones considers the probable effects of introducing other agricultural systems as means of improvement. Plantations, frequently considered to be essential to efficiency and quality, would in his view not only lead to disintegration, but would also be economically precarious on account of the high cost of adequate European supervision. *Métayage* he also rejects, since it suffers from the disadvantage of both large and small-scale farming and, more important, it conflicts fundamentally with the native view of land rights and would require the creation of a now non-existent class of land-owners. Apart therefore from considerations of equity and a policy of trusteeship, he advocates the maintenance of the native system of cultivators' holdings within the territory of tribe and clan, and considers at length, after a review of their history in Europe, the possibilities of technical improvement by the development of cooperative organizations. Although the opportunities for installing more efficient equipment and graded marketing in this way are fully discussed, the group activities which already form part of native farming practice are rather surprisingly ignored. Cooperative development in West Africa should not be limited to schemes based on the

greater individualism of agricultural practice in Europe. The cooperative practices of groups of kinsmen or ward-fellows which are characteristic and widespread may afford an approach to that increase of scale in farming which Mr. Howard Jones appears to accept as desirable so long as the social and economic situation is not abruptly undermined. Such opportunities will probably become clearer when detailed studies of the land holding and economic life in a number of carefully selected areas have been made. Of the urgent need for such investigations the author is acutely aware.

The sketch of native systems of land holding and of ritual sanctions which support them is vivid but over-generalized. The reality and variety of native land-law could have been indicated more effectively by reference to such published investigations as those on the Yoruba and Ibo. But Mr. Howard Jones has stated the case for "indirect rule" in agricultural development very effectively and with great enthusiasm. C. D. F.

NORTH AMERICA

THE RECIPROCITY TREATY OF 1854: Its history, its relation to British colonial and foreign policy and to the development of Canadian fiscal autonomy. By DONALD C. MASTERS. *London: Longmans, Green and Co.*, [1937]. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xxiv + 268 *pages;* 10*s* 6*d*

The middle of the nineteenth century has long been recognized as a decisive period in the constitutional development of British North America, but it is equally interesting and important from the economic standpoint. That standpoint is reflected in such recent work as Professor G. N. Tucker's 'The Canadian commercial revolution, 1845–51' (Yale Historical Publications IX, 1936), which forms an admirable background to this detailed study of the Reciprocity Treaty of 1854. Constitutional and commercial developments were closely connected, for the latter were influenced by the movement towards colonial fiscal autonomy, which was, as Dr. Masters says, "merely one phase of the progress of the colonies toward general self-government." Lord Elgin's work both for reciprocity and self-government symbolizes the connection between the two movements.

The demand of the North American colonies for reciprocity with the United States arose as a result of the free trade movement in England, and especially the repeal of the Corn Laws, which practically destroyed the system of intra-imperial preference. The United States were apathetic, being involved in domestic issues which were to culminate in the Civil War. The colonies were divided on the question of American access to their fisheries, which was a *sine qua non* of American acceptance of reciprocity. It was ultimately the desire to end the friction over the fisheries that led the British Government, by then involved in the Crimean War, to push on negotiations for that reciprocity which, despite its free trade appearance, was in reality a breach of the free trade policy so recently adopted. These negotiations were successfully carried through by Elgin in the spring of 1854. The resulting treaty provided for reciprocal free access to coastal fisheries and free exchange of natural products between the North American colonies and the United States.

For three years the Treaty met with general approval, and then began a period which Dr. Masters calls "Reciprocity in decline," a period which ended with the formal abrogation of the Treaty by the United States in 1866. It is not easy to assign any single cause for this, but the most important appears to have been the adoption of higher duties on manufactured goods by Cayley and Galt in 1858 and 1859, which antagonized the American manufacturers. The Treaty had already become a subject of controversy when the Civil War

increased the friction between the United States and British North America. Against such a background political prejudice and economic discontent were sufficient to secure abrogation of the Treaty, despite the efforts of the home and colonial governments to save it.

Dr. Masters has written what may become the standard work on the Treaty of 1854. He has used a wide range of materials drawn from the Public Archives of Canada at Ottawa, the American Department of State at Washington, and the Public Record Office in London. These he has combined into a detailed study of the Treaty in its relation both to British colonial policy and to the wider development of Canadian fiscal autonomy. He concludes with a judicial analysis of the actual operation of the Treaty, which is difficult to assess, for reciprocity was in force at a time of great economic advance. Though many in the colonies were disappointed at the results of the Treaty, and more still at its abrogation, there was, in 1866, no going back to a policy of annexation but instead an advance to confederation.

T. S. W.

THE *EJIDO:* Mexico's way out. By EYLER N. SIMPSON. *Chapel Hill: University of North Carolina Press* (*London: Oxford University Press*), 1937. $9\frac{1}{2} \times 6$ *inches;* xxii+850 *pages; illustrations.* 22*s* 6*d*

Mr. Simpson has produced a book of authority, the fruit of eight years' research work in Mexico. No one interested in Mexican social problems should be unacquainted with this careful and well-written study; it clarifies the case for land distribution; and while Mexico alone is the subject of Mr. Simpson's volune, many other countries have similar questions to face.

The *ejido* land unit is at the heart of almost all Mexican economics. The author traces the intricate problem of land tenure from the days of the Aztec rulers to the Spanish Conquest, through three hundred years of Spanish colonial rule, and the succeeding hundred years of republican administration until the revolution of 1910. At the base of all popular demands causing and following the overthrow of Don Porfirio Diaz was the unextinguished land hunger of the native Mexican peasant; and for the last twenty years or so Mexican Governments have necessarily placed agrarian reform in the forefront of political programmes.

The dream of the author, remarks Dr. Beteta, is of a Mexico of small industrial villages, "a carefully planned country without waste and without poverty, in which each *ejido* will be imbued with the spirit of cooperation and a keen feeling of its collective interests, where each *ejidatario* will enjoy, together with technical education and a high standard of living, freedom from fanaticism." The author thinks that something like this Utopia might be the reasonable outcome of Mexico's past and present. He explains in detail the ancient pre-Spanish system of land-holding, with its "patriarchal communism," shows the effect of European domination, and the even more drastic results of industrial development by foreign capital, a feverish development that reached its greatest height during the latter part of the long rule of Diaz. Mr. Simpson marshals the facts of the "rape of the pueblos," and shows the progress of reform from 1915 onwards. Using a large number of graphs to illustrate his thesis, he demonstrates the productive capacity of agricultural land in Mexico, national water supplies, the number of livestock on pastures, and forest resources. He deals with the financial aspect of agricultural production; with popular education; credits and markets; and, at a length which does not diminish its interest, with the present condition of the *ejido* system.

Well written and well documented throughout, the volume possesses an excellent index and bibliography. Many of the photographs are excellent.

L. E. J.

CENTRAL AND SOUTH AMERICA

THE CACTUS EATERS. By JULIAN A. WESTON. *London: H. F. and G. Witherby*, 1937. 9×5½ *inches; 240 pages; illustrations and sketch-map.* 10*s* 6*d*

This volume is concerned, almost exclusively, with the rarely visited peninsula of Goajira, jutting into the Caribbean Sea from northerly South America. A mere strip of coastline of this peninsula is owned by Venezuela, the chief extent of territory belonging to the Republic of Colombia. It is a strange region, a geographical outpost of the sub-continent, separated from the mainland not only by its peculiar conformation but by its distinctive flora and fauna. The Goajira peninsula has attracted the attention of ethnographers as well as of geographers, because its sea-washed boundaries shelter an enclave of "wild Indians" probably as little mixed with non-American blood as any still to be found in the New World. The secular intransigence of these native folk, together with the inaccessibility of the peninsula (and, so far as is at present known, lack of resources that might attract capitalists), have contributed to the preservation of primitive conditions in a little land almost within sight of the commerce of the Panama Canal. The first scientific study of the Goajira people was made some twenty years ago by Baron von Nordenskiöld.

Mr. Weston says that after experiences in the oil-fields of the Maracaibo region, and unsuccessful attempts at farming in Costa Rica, he and his partner decided to study the Goajira peninsula from all angles; and, obtaining the cordial assistance of the Colombian Government, entered the country armed with rifles, cameras, and typewriters, in addition to the equipment of explorers. The place of entry was Rio Hacha, unfavourably known in Spanish colonial times. The author thinks that to-day the native Goajiro is "Indianizing Riohacha," and that European influence diminishes. From here, and with the help of small coasting boats touching even less-frequented anchorages, Mr. Weston penetrated the wild peninsula, often on horseback. Sincerely interested in aboriginal life, he deplores the established trading which leaves Indians with "the inevitable rum bottle"; nevertheless, he seems to believe that peninsular native customs will prevail eventually.

The author might note that Cartagena is not, as he thinks, the "oldest city" in the New World; that Henry Morgan cannot, since he sailed to Panama with orders from the Jamaica authorities, be called a "pirate"; and that there are no "black" natives of the island of Curaçao.

Glossary and index are adequate: photographs excellent. This is a useful and well-presented volume suited to the library of lovers of travel and of persons interested in the ethnography of native America. L. E. J.

AUSTRALASIA AND PACIFIC

BOTH SIDES OF BUKA PASSAGE: An ethnographic study . . . in the North-Western Solomon Islands. By BEATRICE BLACKWOOD. *Oxford: Clarendon Press*, 1935. 9×5½ *inches;* xxiv+624 *pages; illustrations and sketch-maps.* 35*s*

Cultural anthropology means, firstly, the observation of native cultures; and, secondly, the formulation of general laws and the discussion of particular problems concerning the inter-relationship of cultural facts. Miss Blackwood's book does not attempt to proceed beyond the first of these stages: the ethnographic description of a Melanesian culture. It is necessary to stress this point in order that the book may be judged in terms of the task which the authoress has undertaken. Considered in this way, it is one of the most comprehensive

ethnographic surveys yet produced. All phases of native life are considered, the six hundred pages contain a wealth of useful observations, nor does she neglect the simple affairs of every-day life in order to startle the reader with queer ceremonies and beliefs. Though it is true that whoever reads this book must bring to it his own scientific problems, he will find in it a mass of valuable information which is clearly set down, adequately documented, and often illuminated by reference to individual cases.

Buka Passage separates the islands of Buka and Bougainville, the most northwesterly of the Solomon group. Most of her information was obtained in the village of Kurtatchi, on the north coast of Bougainville. Her studies, though concentrated upon information on sex, marriage, childhood, and economic matters, covered all the traditional categories of native culture. In a final chapter she provides information on dreams, an ethnographic field now raised to the status of scientific study largely by the work of Professor Seligman, whose critical and empirical approach is closely followed. A number of native dreams are recorded, and to some extent related to the beliefs, customs, and institutions described in the main body of the text. Miss Blackwood's comments on these dreams, though brief, are valuable, and differ from some interpretations of primitive dreams in not seeking to impose ready-made European analyses upon psychological phenomena which are products of a totally different cultural and moral environment.

Since the work is composed mainly of straightforward description, there is little room for criticism on theoretical grounds. But the reader may be tempted to query some of Miss Blackwood's interpretations of native attitudes in simple European terms: "That they accepted me as a member of the community they showed when, on my return from a journey, they performed the appropriate ceremony for me as they would for one of themselves under like circumstances, and clinched it by saying: 'Now you really belong to us' " (p. xxii). But such statements as that on p. 196 raise doubts: "Everything connected with the *tsapi* ceremony is kept very secret from the women, but men and boys were willing enough to tell me about these matters when there were no women within earshot." Surely if she had really been "accepted as a member of the community" she would have been kept in ignorance as were the native women, and anthropology would have been the poorer by a valuable body of information on male initiation. Cooperation and courteous gestures towards a friendly alien who displays a sympathetic interest in native institutions are not to be confused with acceptance as a member of the community.

Again, in regard to the native attitude towards the handing over of ceremonial currency at marriage, discussion with informants gave her the impression that "no distinction existed in their minds between paying for a wife and paying for anything else of importance" (p. 98). She is not dogmatic on this point, and it may be questioned whether her formulation represents the native attitude in Bougainville or in any other human community. It is impossible to equate economic interchanges at marriage to ordinary economic transactions. The point is of vital importance, firstly because of the futile terminological controversies which have raged around the problem of bride-price on the assumption that one European distortion of the native reality is better than another; and, secondly, because of the practical implications in the attitudes taken up by missionaries and administrators towards marriage economics among primitive people. The actual facts adduced by Miss Blackwood are open to another interpretation: that the economic aspect of marriage is in certain respects comparable with other economic transactions, and that words equivalent to "pay," "buy," "steal," are used in a metaphorical sense in order to regulate moral attitudes

towards marriage in ways which present a limited parallel with the rules of property. Both scientifically and practically it is necessary to distinguish such partial analogies from a simple equation of attitudes.

But however much one may be tempted to criticize some of Miss Blackwood's formulations as inadequate, they must be weighed against the wealth of cultural detail and solid fact which the book contains, and for this we owe a debt of gratitude to the ethnographer for putting on record so thoroughly and comprehensively a native culture which may soon share the fate of its neighbours.

R. P.

I VISIT THE ANTIPODES. By CHERRY KEARTON. *London: Jarrolds*, 1937. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 224 pages; illustrations.* 8*s* 6*d*

Here is an account of a prominent British nature-photographer's visit to Australia. Mr. Kearton, who is well known for his writings on various aspects of nature, has given us a simple record of his impressions of quaint creatures such as the platypus, the koala, kangaroos, the satin bower-bird, and the incomparable lyrebird, which he was shown by local observers during his visit to the "island-continent." Unfortunately however the book abounds with irritating inaccuracies which could have been easily rectified. A typical example is the repetition of the statement that trap-door spiders are dangerous. Actually it is the funnel-web (*Atrax*) and red-spot (*Latrodectus*) varieties which kill people so often in certain parts of Australia.

Mr. Kearton could have written a much more enjoyable book. It is of no great interest to the average reader to be continually reminded that the author had "penetrated into the fartherest and darkest corners of Africa," had "photographed wild life in places which few if any white men have ever seen," and had "faced death a hundred times in the wild." His Australian wanderings were confined to the coastal strip of the two most populated States. Despite its obvious deficiencies, the book is valuable in that it gives a good general idea of the prevailing conditions in Australia and New Zealand. If one can conquer a natural irritation at being told three times in a single chapter that Sydney has "palatial cinemas," then there is a wealth of interesting information for the person who would learn something of the delights of a naturalist in the Antipodes. The last four chapters deal with New Zealand and are illustrated, as are the others, with admirable photographs.

A. J. M.

POLAR REGIONS

VIKING SETTLERS IN GREENLAND, and their descendants during five hundred years. By POUL NØRLUND. *London: Cambridge University Press—Copenhagen: G.E.C. Gad*, 1936. $9\frac{1}{2} \times 7$ *inches; 160 pages; illustrations, sketch-maps, and plans.* 7*s* 6*d*

The story of the Norsemen who colonized south-west Greenland has a unique fascination. They lived there for close on five centuries, a period twice as long as that during which the British have been in India. They were self-subsistent in almost everything; iron was the only substance they really lacked, and that deficiency reflected a shortage of fuel.

Much archaeological research has been carried out in Greenland during the last fifteen years. Professor Nørlund is well known as the leading authority on the Norsemen of Greenland. The present book is a translation, not always adept, of one that appeared in Denmark intended for a general public. In treating the historical information obtained from the sagas the author had to choose between an elaborate argument replete with footnotes or a simple uncritical

statement. Professor Nørlund chose the second alternative. The richness of his knowledge of the contemporary life in Iceland and Scandinavia illuminates the discussion of the Norse relics in Greenland and the contemporary European records of contact with these remote people, the extent of which he traces brilliantly. He has some harsh words for the monopoly which forbade others to trade with Greenland even when it had itself no intention of maintaining communication; and for the bishops appointed to the diocese who had no compunction in abandoning their flock to their dismal fate. The remarkable finds of clothing at Herjolfnes have shown that at least this part of the settlement had contacts with Europe until as late as the fifteenth century. As for the end, there is no doubt that malnutrition was an immediate cause, hastened by a worsening of the climate. But the prime cause was the break in communications, and this in turn was due to the new developments in ships which made the German Hanseatic sailing vessels superior to the Viking boat. The new ships were too large and costly to be risked in the navigation to Greenland; and the older type had been superseded. According to Professor Nørlund it was the existence of the Norsemen themselves which induced the Eskimos to migrate southwards. Had communication been maintained the Norsemen would have had iron, which was an essential material of their culture. With iron their agriculture might have been more successful, and the raiding Eskimos might have been repulsed. It is interesting to consider how the Norsemen might have fared had they been less conservative in their habits. They made no concessions to the climate or the conditions in Greenland: their clothing was more suitable for a Copenhagen street than for Greenland, and their culture being essentially Icelandic, they were in Greenland immobile—a great disadvantage in the Arctic. Their story is a curious combination of the pathetic and the courageous. M. A. S.

PHYSICAL AND BIOLOGICAL GEOGRAPHY

THE CLIMATES OF THE CONTINENTS. By W. G. KENDREW. *Oxford: Clarendon Press*, 1937. (Third Edition.) 9×5½ *inches;* xii+474 *pages; maps and diagrams.* 21*s*

The appearance of a new and revised edition of 'The climates of the Continents' is an event of importance to all students of geography and meteorology. It achieves the author's aim, providing "an adequate description of the actual climates of the earth, considered regionally." He begins with a brief account of the nature of climatic statistics, followed by an account of the relationship of winds to pressure distribution. He then discusses each continent in turn. The general features of climate are first considered, mean distributions of pressure, wind, temperature, and rainfall being illustrated by very clearly drawn maps. Differences in type of climate between different parts of the areas described are clearly brought out. At the end of the discussion tables are given of monthly and annual mean temperatures in degrees Fahrenheit, and of monthly and annual rainfall totals in inches. Not least of the advantages of the book is the uniformity of the units used. Temperature and rainfall data are given for 112 stations in Europe.

Such a book may be judged from two rather different points of view, either as a text-book or as a work of reference. The present reviewer has in the past found that the clarity and completeness of Kendrew's book made it eminently suitable as a text-book for students of meteorology, and he has always found it to be a most useful book of reference. Scarcely any question involving mean temperature or rainfall can arise concerning which Kendrew does not give some

information, and if the appropriate part of the text is consulted together with the tables, the statistics can be interpreted in a sound manner. Particular care in this respect is necessary in consulting the tables for places on the borders of the desert regions, where a few rainy days occurring at widely separated intervals of time may give an annual mean rainfall of appreciable amount, although no rain may fall in some years. Thus Kendrew points out that south of Cairo there is a region with a mean annual rainfall of less than 1 inch, in which after ten or even twenty years with no rain, a sudden violent storm may give 1 or 2 inches of rain. This is a type of information which obviously cannot be gleaned from tables alone, and it is clear that the statistical data must be intelligently interpreted, if wrong ideas as to the climates of the fringes of the deserts are to be avoided.

The data employed in the production of the tables in the new edition appear to be the latest available. The author is to be congratulated on his success in not only having succeeded in summarizing clearly an enormous mass of information, but also on having infused into the book a great deal of human interest. Where this is appropriate he has not failed to consider the bearing of the facts on human life. The present reviewer finds little in the book which he would have asked for in a different form. He only regrets the inclusion of Fig. 1, representing the form which the wind systems of the globe would take if the surface were uniform. Dr. Harold Jeffreys has shown that the hypothetical system shown in this diagram could not persist. This is however a minor criticism, and in no way detracts from the value of the book. D. B.

INTRODUCTION TO THEORETICAL SEISMOLOGY. By J. B. MACELWANE and F. W. SOHON. Part I. Geodynamics. By J. B. MACELWANE. *New York: John Wiley & Sons. . . . London: Chapman & Hall*, 1936. 9×6 *inches;* x+366 *pages; illustrations.* 30*s*

The writer of a treatise on any young and rapidly growing subject has a particularly difficult task in maintaining a proper balance between technique, results, applications, and historical development; in seismology few are better qualified for the task than Father Macelwane, and readers of the complementary volume on Seismometry (by Fr. Sohon) will welcome the completion of the project. A large amount of theoretical investigations as well as of seismological information is contained in this book, and on the whole the bibliography is adequate, yet there is no impression given that this is a mere compendium. The subject-matter is well set out and the printing good, and the work is as up to date as a text-book on a developing subject very well could be.

The first half of the book is taken up with a careful exposition of the theory of the propagation of elastic waves through the interior of a solid, and with waves of the Rayleigh and Love types over the plane surface of a solid, and further, with the theory of the reflection and refraction at an interface. It is perhaps in the length and presentation of this part of the subject that the chief fault lies. The theory is suited to the requirements of a class of students, who might need a short, self-contained course, rather than to a theoretical or practical seismologist; it is not surprising to find that the book has developed from lecture notes.

The second half of the book is much more valuable. Chapter VIII, on the paths of seismic rays, explains in detail how the times of transit of P and S waves can be made to yield information about the properties of the Earth's interior. The evidence for the different internal discontinuities is not very critically presented; there is insufficient evidence of the order of accuracy of the determinations, and the reader might well infer that the so-called Repetti and Dahm

discontinuities were as well established as the Oldham-Gutenberg transition from solid crust to liquid core, or the well-defined differences in the continental layers: the Byerly-Lehmann-Jeffreys-Bullen discontinuity, which is just reached by waves travelling an epicentral distance of 20°, is not mentioned at all. Chapters on the interpretation of seismograms, the determination of epicentres, and the depth of focus are very interesting and useful, but the two last named might well have come in the other volume. The author appears to have little interest in the surface-wave phase of a seismogram; yet this is the most conspicuous feature of a normal record. There is no reference to the importance of dispersion, or to the information yielded about the structure of the continents and the ocean floors, and the inaccurate statement is made that "Love also investigated the effect of . . . a superficial layer on Rayleigh waves and found that it has very little influence except to increase the velocity slightly." The inclusion of a few topics of general interest such as the geographical distribution of seismic activity (particularly Wadati's work on the depth and distribution of foci), the work of A. W. Lee on microseisms, the properties of matter in relation to rupture and viscosity, with a short account of some of the work that has been done on the diffraction of elastic waves, would have made the book of interest to a far wider circle of geophysicists, geographers, and geologists; had the first half of the volume been cut down to reasonable limits, space could easily have been found for such questions.

Considering how much space is taken up with formulae the number of misprints is small. It is stated on p. 147 that the nomenclature P and S waves was suggested by Jeffreys; actually, the use of these initials ante-dates by some years Dr. Jeffreys' researches, and they appear to be due to Weichert and Borne (1904). A pocket at the end of the book holds a Brunner Depth Chart, which affords a means of rapidly estimating the focal depth of a deep-focus shock. The author is to be congratulated on his achievement; when the growth of the subject necessitates a new edition, he may perhaps see his way clear to embody the additional matter which will appeal to a larger class of readers. R. S.

LEHRBUCH DER PHYSIKALISCHEN GEOLOGIE. By ROBERT SCHWINNER. Band I: Die Erde als Himmelskörper; Astronomie, Geophysik, Geologie in ihren Wechselbeziehungen. *Berlin: Borntraeger*, 1936. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches;* xii+356 *pages; illustrations and maps. M.*14.60

This is an interesting book, in which much information, mainly astronomical, is collected, and its possible applications to problems of the Earth's origin and history are indicated. The discussion is very critical, and much of the material, notably that relating to meteorites, is not easily accessible. A curious omission is that of all reference to the Monthly Notices of the Royal Astronomical Society and its Geophysical Supplement, though there are many quotations from summaries of papers given afterwards in *Nature* and elsewhere. Consequently in places the book is not as up to date as it might be. The reviewer however appreciates the author's lightness of touch. H. J.

DIE ENTWICKLUNG DER KONTINENTE UND IHRER LEBEWELT. By THEODOR ARLDT. Zweite . . . Auflage. Erster Teil. *Berlin: Borntraeger*, 1936. $10\frac{1}{2} \times 7$ *inches;* 448 *pages; sketch-maps. M.*28

The object of the author in this work seems to be to trace the affinities of the various land masses of the earth by means of biological data. The first section deals in brief outline with the various physical methods which have hitherto been used. By far the greater part however consists of lists of animals and plants

belonging to the different regions and sub-regions into which the world is divided. It is a compilation which loses a great deal of its value because the author has omitted two important points in the presentation of his work: an introductory statement on the exact nature of the problem and a summary of any conclusions he may have reached. Even a synopsis of the contents is lacking. There seems to be little of novelty although there is a vast amount of compiled information with a very exhaustive footnote reference for those who have time to study it carefully. J. D. M.

MOUNTAIN GEOGRAPHY: A critique and field study. By RODERICK PEATTIE. *Cambridge, Massachusetts: Harvard University Press (London: Humphrey Milford)*, 1936 [1937]. 9½×6 *inches;* xiv+258 *pages; illustrations and maps.* 17*s*

The title and preface of this book suggest that it has a wider field than that actually covered. It is an excellent critical summary of certain aspects of the mountain geography of parts of Central and Southern Europe, treated mainly in an analytical manner. The first three chapters are on the elements of climate, and contain detailed analyses and explanations of the meteorological factors, based on records, with such generalizations as the author thinks statistically justified; constant references are made to human responses to the climatic conditions. The next four chapters deal with utilization of mountainous areas, treating of cultivation, forestry, pastoral work and transhumance, types of economy and recent changes. Finally there are chapters on population and its distribution, on political reactions to mountain situation, and on the "character of mountain life." As in the previous chapters, the treatment is based on carefully selected facts, often expressed quantitively, and the whole is illustrated by photographs and by a number of relatively large-scale sketch-maps. In many instances Professor Peattie quotes his personal observations and gives descriptions which lighten the reading of a closely written and thoroughly documented study. In addition, there is a long, classified and annotated bibliography.

An extraordinary feature of the book is its omissions and the limitation of its outlook. Its claim to be a general study of mountains and mountain life is vitiated by the omission of any treatment of the greater part of the world's highlands. This involves ignoring important types of mountain climate, as for example where, in equatorial latitudes, there is little seasonal change in temperatures and insolation, while on the human side there is practically no consideration of the influences of altitude upon societies and economies other than those of Europe. Moreover, in connection with the regions which are specifically treated, there is the unexplained omission, or relegation to the merest background, of all the geological factors. There is an appendix of "Bibliographical notes on the geomorphology of mountains," but in the text the structure of mountains is entirely ignored. It might be argued that in conformity with a statement in the preface that "only those facts from physical geography are selected which are pertinent to a knowledge of human relations," theories of mountain building have been excluded, but even land-forms and rock composition are referred to only in connection with some other phenomena; the *karst* type of landscape with all its human consequences is not mentioned. Perhaps still more remarkably glaciation, which is so important in those areas to which special attention is given, has only a few incidental references, the longest of which extends to four lines.

Possibly related to this exclusion is the neglect of certain aspects even of the human geography. The author writes that "the industrial future of most mountain areas depends upon water power," but only two other sentences

suggest that there has been any development of water-power and associated industries. There is no systematic treatment of communications and routes, and the weakness of the book in this connection is indicated by a phrase: "Italy . . . holds Fiume, except for inconsequential Sušak . . ." from which one would scarcely gather that Sušak has become the most important port of Yugoslavia.

It seems a matter of great regret that Professor Peattie has not extended his careful study to all the aspects of the geography of the mountains with which he mainly deals, and that the regional limitation of his work is not indicated in the title. J. F. U.

CARTOGRAPHY

PIRI REIS HARITASI (PIRI REIS' MAP). [Publication No. 1 of the Society for Turkish Historical Research.] *İstanbul: Devlet Basımevi* [*Leipzig: Gustav Fock*], 1935. İzahname [Explanatory note], in Turkish, German, English and French. By YUSUF AKÇURA. 13×9½ *inches; 21 pages. Facsimile* (dated 1933) *of map* (drawn 1513) *and transparency* (*with legend in Latin character*) in separate case (14½×12½ *inches*). *M.30*

We have here a first-rate photographic reproduction, in the colours and size of the original, of the remarkable Turkish map of the early sixteenth century (1513) brought to light a few years ago at Istanbul, which was described and discussed by Dr. Kahle in the monograph noticed in the *Journal* for September 1933. The present publication includes, besides the map itself, a brief description by the President of the Society responsible for its issue, printed in Turkish, German, English, and French, setting forth its main points of interest, and—the most valuable part—giving a complete transcription of the substance of the map in these four languages. Besides this, all the Turkish names and legends are printed in their proper places in Roman characters on transparent paper capable of being superimposed on the map itself: useful to those with some knowledge of the language. No attempt is made to discuss controversial matters, Dr. Kahle's contention that the American portion closely reproduces a map by Columbus himself being accepted as probably correct. While therefore adding somewhat to the information given by Kahle (who contented himself with giving copious extracts from the legends) it in no way supersedes the German monograph. Difficulties of interpretation still remain, and the legends near the right-hand margin are incomplete owing to the mutilation of the map, for there is little doubt that it originally included the whole of Asia, giving a general picture of the world as then known. The editor points with pardonable pride to the evidence afforded by the map that, even in the early sixteenth century, some at least of his countrymen were in close touch with Western culture.

The reproduction does great credit to the Turkish State Press responsible for it, and we can fully believe that, as stated by the editor, there is little outward difference between it and the original. It naturally gives a more vivid idea of the character of the original than any black-and-white copy such as accompanied Dr. Kahle's paper. E. H.

THE WORLD IN MAPS: A study in map evolution. By W. W. JERVIS. *London: George Philip & Son*, 1936. 9×5½ *inches; 208+24 pages; illustrations and maps. 7s 6d*

Professor Jervis has aimed in this book at a study of "the origin and development of the map-idea" which will assist the general reader to appreciate the value of maps and to use them with discrimination. The opening chapters deal with the elements of the map, scale, projection, relief, lettering, and other details;

the second half is devoted chiefly to certain aspects of the history of cartography, concluding with a chapter on maps in the modern world. Professor Jervis is obviously an enthusiast for his subject, and his book will communicate some of this enthusiasm to his readers, who will also gather from it a number of out-of-the-way facts, and some interesting suggestions. It is necessary however to point out that, in addition to a number of misprints, there are numerous statements on cartographical history which can be due only to complete misapprehensions on the part of the author. This historical aspect is of considerable importance, for the plan of the book necessitates continual historical references. In the chapters more definitely given to the history of maps, the author, for a reason not apparent to the reviewer, abandons chronological sequence and works back from eighteenth-century cartographers to those of earlier periods. It is thus difficult for the reader to obtain a clear view of the development of cartography. Further, the annotated chronological list of maps in the appendix contains statements which conflict with those in the text, and has its own errors. Some of the mis-statements in the text may be noted: there is no evidence that the makers of the early portolan charts employed the quadrant and astrolabe; printed editions of Ptolemy had appeared before 1490; Edward Wright is not known to have published a world map, and certainly not in 1590 (this statement appears to have resulted from a confusion between the Molyneux globe of 1592 and the so-called Hakluyt-Molyneux-Wright map of 1600); there was no connection between the 'Theatrum' of Ortelius and Braun and Hogenberg's 'Civitates Orbis Terrarum,' as implied on p. 158; nor is it correct to imply (p. 100) that Nowell had drawn a series of English county maps before Saxton published his atlas. It seems improbable that Waghenaer's charts owed anything to the Catalan Atlas. No mention is made of such land-marks in cartography as Lily's map of the British Isles (except for a mis-statement in the appendix), Lafreri's cartographical work, or the first French atlas by Bougereau. The chronological list of maps shows evidence of very hasty compilation. The most extraordinary statement is that in 1546 "George Lily published a large map (made by John Speed) in Rome." The use of the word "published" is also misleading, *e.g.* "1600–1 Norden published the results of an estate survey of the Orford district," or "*Circa* 1300, Carte Pisane, drawn by a Genoese cartographer and published in Paris . . ." Another obscure statement is that on Alonzo de Santa Cruz's world-map "The prime meridian passed west of the island of Fayal, through Java and Annam." G. R. C.

ECONOMIC AND HISTORICAL GEOGRAPHY

RIM OF CHRISTENDOM: A biography of Eusebio Francisco Kino, Pacific Coast pioneer. By HERBERT EUGENE BOLTON. *New York (and London): The Macmillan Company*, 1936. 9½×6 *inches;* xiv+644 *pages; illustrations and maps.* 25*s*

The American historian, Parkman, has described the work of the Jesuits in New France in his well-known book, 'The Jesuits in North America,' and Professor H. E. Bolton deplores the fact that the Jesuits of New Spain have not received the attention which they deserve. His book is essentially a biography of the Jesuit Father, Francisco Eusebio Kino (1645–1711), little notice of whose work has been taken in general histories of geographical exploration. It should be remembered that the name Kino is often spelt Kühn by English authors. In 1919, Professor Bolton published a book in two volumes called 'Kino's Historical Memoir of Pimería Alta,' which work contains Kino's 'Favores Celestiales,' and is really an autobiography of the explorer. The

manuscript was discovered, edited and translated into English by Professor Bolton, and since 1919 interest in the achievements of Kino has grown rapidly. This new book on Kino is based on an immense amount of research in European and American libraries. By the discovery of his writings and maps, and much of his correspondence, it has been possible to produce a full life of "the most picturesque missionary pioneer of all North America—explorer, astronomer, cartographer, mission builder, ranchman, cattle king, and defender of the frontier."

Kino was born in Italy, and after being educated in Germany and spending some time in Spain and Mexico City, he gave up the rest of his life to missionary work in north-west Mexico (Lower California and Sonora) and southern Arizona. His early ambition was to work in China, a country which he never visited. In 1684 he was the first explorer to reach the Pacific by crossing the peninsula of Lower California, and during the succeeding twenty-five years he unveiled the geographical features of Sonora and southern Arizona as far as the Gila; he actually crossed the Colorado. Kino was a trained cartographer and his maps are of great importance, as he was the first to show Lower California as a peninsula and not as an island. The reproductions of manuscript maps are one of the most valuable features of this book. Kino was a practical man of affairs, who introduced cattle-ranching and European fruits and cereals into the regions of America which he explored. The old popular idea that the Spaniards were only explorers and seekers after gold is dispelled by the descriptions of Spanish ranches such as that at Puebla de los Angeles, which contained "80,000 hogs, 20,000 sheep, and many thousands of cattle."

This is a work of elaborate scholarship, but the footnotes and bibliographies should not discourage the general reader from using it. A complete life of a very remarkable man has been given, presenting a graphic and often amusing picture of the daily round of a pioneer missionary in America. Professor Bolton says that "the Spanish Jesuits in North America await their Parkman," but this scholarly life of Kino is as readable as the classic works of the New England historian. The title of the book is best explained by the following extract: "Kino was in the fullest sense a pioneer of civilization. But to him all this was incidental. His one burning ambition was to save souls and push outwards the Rim of Christendom." E. W. G.

GENERAL

MOUNTAINEERING. By SYDNEY SPENCER (Editor) and others. (The Lonsdale Library, vol. xvii.) *London: Seeley Service,* [1934]. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 384 *pages; illustrations and maps.* 21*s*

Mr. Sydney Spencer has undertaken the editorship of a book which embraces both the technical and topographical aspects of mountaineering, and he has produced a volume which is thoroughly representative of the sport and worthy to take its place beside other well-known works in the Lonsdale Library. He has called upon a number of British, Continental, and American experts to fill some 369 pages with information varying from technical minutiae to mountaineering on such widely different terrains as the Cornish cliffs and the jungle-clad hills of Korea. Professor Graham Brown contributes an opening chapter on early mountaineering, in which he points out the sporadic nature of the early ascents, though many will dispute his assertion that "mountain climbing does not make a natural appeal to mankind." Not until the last century did mountaineering emancipate itself as a sport, except for one or two pioneers such as Father Placidus a Spescha, whose regard for the hills was uninspired by the lust for competitive achievement or the pursuit of pure science. Mr. Winthrop Young

follows with "General principles," in which he condenses the tenets of the sport as set down in his book 'Mountain craft,' and Mr. C. F. Meade deals with equipment, and stresses the importance of reconnoitring. Professor Garwood contributes a chapter on "The geological structure of mountains," in which he deals exclusively with the Alps: he might have said something about the British hills. Chapters on mountaineering in various parts of the world are contributed by Mr. Haskett-Smith, Dr. Rickmers, Mr. Speaker, Mr. West, Mr. Porter, Dr. Thorington, Mr. Wordie, Dr. Borchers, and the Rev. Walter Weston. Dr. Longstaff draws on his vast experience in seven chapters on the Himalaya. "First aid," by Dr. Wakefield, rightly finds a place, and so do informative chapters on "Alpine flora" and "Photography," by Dr. Roger Smith and Olaf Bloch. Lastly "Winter mountaineering," a neglected subject prior to the advent of ski, is contributed by Dr. Hoek.

All these subjects are illustrated by sketches or plates, of which last there are 102. Most of the photographic illustrations are good, but some, such as those of Ben Nevis and Ushba, the shapeliest Caucasian peak, do not do justice to their subjects. Incidentally the Caucasus deserves a chapter to itself.

Mountaineers may decry the ultra modern school of mountaineering thought when applied to such climbs as the north face of the Eiger, but it would have been interesting to have included a chapter by one of its leading exponents, if only to understand the motives underlying the desperate Alpine ascents which are now the vogue among young continental mountaineers. Possibly however Mr. Spencer is wise to have omitted such controversial material and to have confined himself to contributors welded to the sound traditions of mountaineering.

Mr. Spencer himself contributes an interesting account of "Alpine Clubs and Societies," of which there are now many. A glossary renders the text intelligible to the lay reader, but the index is by no means complete.

The book should be useful not only to the beginner in mountaineering but to those who seek preliminary information on mountaineering in different parts of the world, concerning which the bibliographies of the various districts will prove valuable. Mr. Spencer is to be congratulated on having produced an informative and useful work. F. S. S.

.GONE NOMAD: Twenty years' vagabond wanderings in three continents. By ARCHER RUSSELL. *Sydney, Australia: Angus and Robertson* (*London: Australian Book Co.*), 1936. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* x + 230 *pages; illustrations.* 7*s* 6*d*

This is a remarkable account of indiscriminate experiences of life, varied by details and anecdotes of strange people. It is in five parts. Part I deals mainly with the Australian Bush, the difficulties of "sheep-dodging" and "brumby-running"; Part II with "opal-gouging," etc., in the West Darling country of New South Wales, and a journey on the Darling river. Part III speaks of Central Africa and the Congo borderland, where the author becomes a trader-assistant in a commercial company, combining his duties with various hunting experiences. In Part IV he passes further northward and describes the early days of the Belgian Congo, with his own varying fortunes in that region. Part V tells of brief visits to Portuguese and German East Africa and the author's final return to Australia. The period of his wanderings ends with the outbreak of the Great War in 1914.

The stories are well told, and as a big-game hunter Mr. Russell experienced his full share of narrow escapes from destruction, not only by wild beasts but also by unfriendly tribesmen. There are some good pictures of various antelopes and other animals found in the localities visited by the author. W. G. G.

NORTHWARD HO! being the log of a 35-ton schooner from Sydney to Plymouth. By HAROLD NOSSITER. *London: H. F. and G. Witherby*, 1936 [1937]. 9×5½ *inches; 222 pages; illustrations and route-map.* 10*s* 6*d*

This is an account of a 14,000-mile voyage from Australia to England in a 35-ton staysail schooner. Any yachtsman contemplating an ocean voyage in his own yacht could not do better than read this book and learn the right way to carry out his adventure. The ship was built in accordance with the ideas of the owner, who was convinced that the Bermudan rig was the best for ocean cruising, and he chose the staysail schooner sail plan for its ease in reducing sail-area and its advantages in heaving-to in a gale. The owner was fortunate in having as his crew his two sons, who had plenty of both racing and cruising experience.

The first part of the voyage was particularly interesting and proved the efficiency of the crew. Passing Cape Byron on July 20 they reached Rabaul on August 4. When off the north-west coast of Serang the wind prevented them from making Amboina, so they carried on north of Buru Island. They sailed across the Flores Sea to Komodo, along the coast of Bali, and on to Singapore and Penang. Another stormy passage took them to Ceylon and thence to Aden, and through the Red Sea and the Suez Canal to Port Said. They were badly storm-tossed in the Mediterranean but arrived safely at Gibraltar. A short stay was made and then they started their last lap; after a fair passage they sighted the English coast on the second of June and reached Plymouth before dusk. There are some valuable notes on ocean cruising and an abstract of the log of the *Sirius*. It is a notable book and a notable performance.

H. M. E.

CHANGING HORIZONS: . . . thirty years' wanderings up and down the Seven Seas. By W. ROBERT FORAN. *London: Hutchinson & Co.*, 1937. 9½×6 *inches; 288 pages; illustrations.* 18*s*

The author describes this book as "pages from my scrapbook, covering over thirty years' wanderings up and down the Seven Seas," and the various localities included in his travels are dealt with in the order in which they were visited. Mr. Foran has great powers of observation. He describes many of the customs and ceremonies of the Burmese with a wealth of detail. We are inclined to agree with his remarks on the "despotism of Nat (or spirit) worship" in Burma; and the suggestion that in spite of "the faith that their Golden Pagoda (the Shwe Dagon) inspires" in the Burmese, "any religious festival in Burma is simply an excuse for a beanfeast," will accord with the experience of most. The chapters on St. Helena and the Andaman Islands give good accounts of the conditions prevailing there at the time of the author's visits, though each, and particularly the Andamans, has changed considerably since. The last three chapters treat of the Persian Gulf, and here Mr. Foran is not so fortunate in the detail which he collected: much of it is evidently gleaned from the statements of people insufficiently informed. Shaikh Salim bin Mubarak of Koweit did not enjoy the title of "Sultan," and the British Political Agent at Koweit would be rather surprised to learn that to join the "vast number of composite tribes" of Arabia together was part of his duties.

W. G. G.

THE MONTHLY RECORD

EVOLUTION OF THE NORTH SEA BASIN

To the *Journal du Conseil International pour l'exploration de la Mer* (vol. XI, no. 2, 1936) Dr. L. Dudley Stamp contributes an article on the geographical evolution of the North Sea Basin, which is a sequel to his article on the Straits of Dover in this journal (*Geogr. J.* 70 (1927) 386–90).

He points out that the origin of the North Sea Basin may be traced back to the Hercynian earth-movements of late Carboniferous times; but it is only from the Miocene period onwards that a detailed history can be reconstructed, and even that is subject to much uncertainty.

The absence of Miocene deposits from England has long been recognized as the greatest imperfection in our stratigraphical sequence, but the presence of derived Miocene fossils in the "box-stones" at the base of the East Anglian Red Crag shows that the Miocene sea which, at its maximum, covered the Low Countries and the adjacent part of Germany to beyond the Elbe, came very close to England on the west. In the early Pliocene (Diestian) age the sea covered most of Belgium and part of Kent and East Anglia, while approximating to its present limits farther north. There were as yet no Dover Straits, the Wealden–Artois dome being unbreached; yet the Diestian fauna shows warm-water relationships that indicate some other connection with more southern seas.

Middle Pliocene times were marked by a steady retreat of the North Sea from England, and a great deepening of the Dutch edge of the basin, as shown by deep borings about Amsterdam. In the late Pliocene one of the distributaries of the Rhine flowed over part of East Anglia, depositing the Chillesford beds with their abundance of mica of possibly Alpine derivation.

During the Glacial Period the North Sea was occupied to a varying extent by the Scandinavian ice-sheet. During the second glaciation this sheet and the great eastern British sheet combined to bank up an ice-front lake against the anticlinal Weald–Artois axis, until the water overflowed the lowest col into a south-west-flowing stream-valley which it deepened and widened—the future Straits of Dover.

In early Neolithic times, when the Baltic was an *Ancylus* lake, Great Britain remained widely connected to Europe, half the North Sea, from the Dogger Bank southwards, being land. The submerged forests seen on many parts of our coasts date from this time. There followed a submergence to below present level, as our raised beaches testify; and it was only then that the sea broke through the glacial overflow channel and made Great Britain an island.

Such is, in very brief outline, the late history of the North Sea basin, as interpreted by Dr. Stamp. His account may be criticized in matters of detail—he hardly appreciates the importance of the palaeontological evidence of the extension of the Crag sea to Hertfordshire and Surrey, for instance—but taken as a whole it gives a reasonable and connected interpretation of existing evidence. To what extent these marine advances and retreats are to be explained by eustatic movements of the sea-level, and to what extent by the last phases of the Wealden and associated earth-movements is uncertain: both certainly played their part.

A. M. D.

THE STUDY OF TECTONICS

We have received from the publishers the first part of a new publication entitled 'Geotektonische Forschungen' (Berlin: Borntraeger, 1937), which is to appear two or three times annually. The editors, H. Stille and F. Lotze,

discuss the scope of the subject in a short preface. Though it is defined as the study of the general structure and formation of the earth's surface, the importance of the examination of the smallest tectonic features as guides to what has happened upon a larger scale is stressed, as is also the importance of the historical element, especially epeirogenetical changes. The articles will in the main be concerned with the structure of Central Europe, and particularly of Saxony, on account partly of its inherent interest and the advanced state of existing knowledge, but they also will throw light upon the structural problems of other regions. The methods of study are further outlined by F. Lotze in the first article, and the remaining two deal with the tectonic structure of the region between the Vogelsberg and Rhön, by E. Lemke, and the faults and rifts between the Habichtswald and the Rhine Schiefergebirge, by H. J. Martini. The articles are accompanied by numerous diagrams, and structural and geological maps, some of which are in colour.

NOTE ON THE SOURCES OF THE GANGES

A reference to the source of the Ganges almost inevitably raises the question of why the source sacred to the Hindu religion is situated at the head of a stream which is neither the most distant nor the contributor of the most water to the main river. The most important source of the Ganges is in all probability that selected by Sir Richard Strachey (*Geogr. J.* 21 (1851) 64), the Dhauli, whilst the Hindu sacred source is at Gaumukh at the head of the Bhagirathi. The second most holy source is the Vasudhara at the head of the Alaknanda. The following explanation of the sanctity of this second source, suggested by observations made during a recent trip up the river from Hardwar to the Saraswati source, is one which I have not seen mentioned in any discussion of the subject. It may therefore be worth recording as suggesting how, for similar reasons, the source at Gaumukh has come to be that sacred to the Hindu religion.

At all the major confluences in the portion I traversed the name of the river follows that course which, from downstream, appears to be most nearly straight, irrespective of volume of water or width. At the junctions of the Alaknanda with the Mandakini, Nandakini, and Birehganga (the confluence of the Pindar was not visited) the Alaknanda is the straighter course; in each case however it is also much the larger and wider river. At the confluence of the Alaknanda (locally known as the Vishnuganga) and the Dhauli at Vishnuprayag, the course of the Alaknanda is north and south, and it is practically undeflected by the Dhauli, a river of twice the breadth and volume, which flows in on the left bank nearly at right angles. At Mana, where the Alaknanda and the Saraswati join, the former flows in a gentle sweep from the west to continue southwards down the valley, while the latter pours in through a narrow cleft in the rocks on the left bank of the Alaknanda almost unobserved. At this point the volume of the Saraswati is twice that of the Alaknanda. Thus, starting from above Devaprayag, and carrying the name along the straighter reach at junctions, one is led to the source at Vasudhara.

With regard to the Gaumukh source, at Devaprayag, where the Bhagirathi and Alaknanda join to form the Ganges, the junction takes place in a fairly straight reach of the Bhagirathi, the Alaknanda coming in at a sharp angle on the left bank. At this point the width and volume of water in the Alaknanda is very considerably greater than in the Bhagirathi. It would be interesting to know whether any traveller up the Bhagirathi can confirm the belief that by following the stream in the manner described above, one would be led to the holy source of Gaumukh.

D. R. CRONE.

RELIEF IN THE SUB-ARCTIC

In an article entitled "Relief in the Sub-Arctic" (*Natural History*, New York, November 1936) Mr. P. H. Godsell deals with the plight of the Northern Indians. When it was stated in the Canadian House of Commons that one-third of the Canadian Indians were on relief, Mr. Godsell set himself to examine the causes, and the following are his conclusions. Thirty years ago, when the Hudson's Bay Company was paramount throughout the greater part of north Canada, the Indian was protected as an economic asset, since the fur trade depended on his well-being. The organization of the "farming of the forests" on a family basis lent itself naturally to the conservation of game, only the surplus being trapped. With the coming of the twentieth century the settlement of the North led to the challenging of the Hudson's Bay Company's monopoly, and to the exploitation of the Indians and their game preserves. The railway and aeroplane opened the hunting grounds to numbers of white trappers whose equipment enabled them to destroy the game on a large scale. If the Indian retorted by burning the forests, that in turn led to the drying of the marsh lands and a further drop in the export of pelts. Whereas the Western Indian has been able to take to farming, the Northern Indian is unable to adapt himself to agriculture or industry, and must live on as the recipient of Government charity unless he is to disappear altogether.

It may be added that in the opinion of the Department of Indian Affairs (see Annual Report 1937, pp. 13–16) the only satisfactory solution of the problems is the reservation of adequate areas in which Indians only shall be allowed to hunt; and a number of these preserves have already been established in Northern Quebec and in the North-West Territories.

BRITISH GRAHAM LAND EXPEDITION 1934–37

The *Penola*, after her refit in South Georgia, where she received every assistance and kindness both from the Vestfold Whaling Company and from Messrs. Salvesen, embarked the shore party at the southern base on Barry Island on March 12. She returned with them to South Georgia, whence Messrs. Salvesen had hospitably offered them passage home in their whaler *Coronda*. Seven members of the party, Messrs. John Rymill, G. C. L. Bertram, E. W. Bingham, W. L. S. Fleming, I. F. Meiklejohn, B. B. Roberts, and A. Stephenson, were landed at Las Palmas and arrived at Liverpool in the m.v. *Gascony* on May 17. Messrs. Hampton and Riley, having in their charge the aeroplane and five dogs, went on in the *Coronda* to Oslo to disembark personnel, and back to Rotterdam, whence Riley came to London and Hampton travelled to Leith to deposit the dogs at the Edinburgh Zoological Gardens.

The *Penola*, under the command of Lieut. R. E. D. Ryder, R.N., will come home under sail so far as possible, and is due in England with the ship's party towards the end of August.

The expedition has brought home a rich store of surveys, photographs, and collections. The provisional map constructed by Mr. Stephenson was awaited with some anxiety because, as readers will remember, we had been compelled in constructing the map to illustrate Mr. Lincoln Ellsworth's paper in the *Journal* for March to make certain assumptions. These prove to be in the main correct. Mr. Ellsworth must, as we supposed, have flown over the southern end of the long strait separating Alexander I Island from the unbroken continental coast. It will be of the highest interest to fit the photographs of Sir Hubert Wilkins, on which the provisional geography of the region has been based, into the ground surveys of Messrs. Rymill and Bingham on their journey eastward across Graham Land to the Weddell Sea (see the *Journal*

for March 1937, p. 253), and to reinterpret them with the aid of their ground control.

All the members of the expedition are well. They will be fully occupied during the summer working up their scientific results, of which a first account will be given to the Society by Mr. Rymill early next session.

RADIUM FROM THE GREAT BEAR LAKE AREA

In his presidential address to the Canadian Geographical Society (published in the *Canadian Geographical Journal*, March 1937) Dr. Charles Camsell describes a journey he made in 1900 with the late Dr. Mackintosh Bell in the Great Bear Lake region, and the important result it has had on the world supply of radium. The party set out from Fort Norman in June, and on reaching the lake found it still completely frozen over, except along the shores. Progress along the northern shore was slow as they were often ice-bound owing to the frequently changing wind. At Fort Confidence the huts built for Richardson in 1848 were found to be in perfect condition. Thence an attempt was made to reach the Coppermine river, but failing supplies and bad weather compelled them to turn back. Continuing southwards along the lake shore, the Laurentian region of deep fiords and granite hills was entered, the party camping at Echo Bay on 24 August. In his notes on the area they were passing through, Dr. Bell remarked upon the staining of the steep rocky shores with cobalt-bloom and copper green. After undergoing considerable hardships, the travellers crossed the then unexplored country to Great Slave Lake, and finally reached Edmonton in December.

In 1930 Mr. G. La Bine, a prospector, came upon Dr. Bell's reference to cobalt-bloom around Echo Bay, and knowing its relation to native silver, flew to Great Slave Lake and inspected the occurrence. On his return the Mines Department confirmed the presence of pitchblende, indicating a source of radium. The result of further inspection in the following year convinced him that the area was worth developing. The Department, after prolonged experiment, evolved a method for reducing the ores. Production of radium began at Port Hope in 1933, and this plant is now the principal world source of radium. As a result the price of radium has been reduced by one-half. The occurrence of rich silver-bearing ore has also added to the value of this mining area, which is being developed 1500 miles from a railhead.

OBITUARY

LORD CONWAY OF ALLINGTON 1856–1937

By the death of Martin Conway the Society has lost one of its most eminent Fellows and his large circle of friends, in many walks of life, a companion of the rarest quality. Only through personal contact were the remarkable charm of his character and the riches of his mind—for his erudition was catholic—revealed. He is known to us as an explorer; but art, antiquities, ethnology, practical politics in and out of Parliament, and work for the preservation of beauty in art or nature occupied his mind and activities to an even greater extent. Every object of beauty or romance appealed to him strongly to the end of his life. To the very last he retained the whimsical humour which kept him always laughing and always young. His companions, Bruce among them, have testified to the fillip that his companionship gave to life and living.

What Freshfield did for the Caucasus Conway did for the Himalaya. His expedition to the Karakoram in 1892, with his surveys of the Hispar and Baltoro regions, his ascent of Pioneer Peak (about 23,000 feet and for many years a record), and above all the publication of his book illustrated so delightfully by A. D. M'Cormick, introduced a new world to the mountaineering public. That his surveys have been criticized in detail is the inevitable fate of every traveller bold enough to publish the first map of any region. But his was the first glacier survey on a grand scale from High Asia. Two years later his 'Alps from end to end,' describing his journey of 1894, during which he introduced two of Bruce's Gurkhas to the Alps, brought inspiration to young mountaineers who were being told that the Alps were played out. His delightful paper "Centrists and eccentrists," in the *Alpine Journal*, had the same effect, giving a priceless lead to alpine thought and practice of the day. His 'Zermatt pocket book,' the first of technical climbers guides, was a boon to the growing school of young English guideless climbers following in the steps of the Pilkingtons and the early apostles of the craft. In 1896–7 we find him exploring central Spitsbergen with Garwood. In 1898 he made probably the most successful mountaineering expedition of his life. In the Bolivian Andes he climbed Sorata and Illimani. Then, far to the south, he made the second ascent of Aconcagua. The first ascent by Fitzgerald's guide and Vines was considered the altitude record of the time. It was typical of Conway that he refrained from stepping on to the actual summit point in order to be able to say that he did *not* hold a record. I can see his puckish smile as, after that most laborious of ascents, he inclined his head to the mountain top beneath his eyes, but would not place his foot there. Down to Tierra del Fuego he followed the Andes to the soaking and impenetrable thickets of Sarmiento.

Lord Conway was President of the Alpine Club 1902–05. Like most mountaineers wide travel made him only a more confirmed lover of the Alps, as can be seen in his 'Mountain memories,' published in 1920. His practical mind made him undertake the presidency of the *Ligue pour la Conservation de la Suisse pittoresque* to whose efforts are due the blessing of a Matterhorn still undefiled by a funicular.

He joined our Society in 1893, served several periods on the Council, and was also a Vice-President. In 1905 he received the Founders Medal.

Conway was a great art critic. His book on the Van Eycks is considered a masterpiece. His first chair was at University College, Liverpool. He was a trustee of the Wallace Collection and of the National Portrait Gallery. He was Director-General of the Imperial War Museum. He was a Vice-President of the Society of Antiquaries and a very active member of the Royal Commission on National Museums and Galleries. His restoration of Allington Castle is a creative work of art in itself.

His political career might be said to commence with the publication of his remarkable book 'The crowd in peace and war' in 1916. In 1918 he was returned as a Unionist by the combined English Universities. His reputation as an authority on art and as an explorer perhaps limited his success in another sphere reserved for professionals; but he was extremely popular in the House, which is an infallible judge of character, and probably owed his peerage mainly to the universal affection and regard in which he was held by all parties.

To Lady Conway and to his daughter, the Hon. Mrs. Horsfield, everyone who had the privilege of knowing this most delightful of men must wish to convey their feelings of sympathy together with the confession of their own intimate sense of loss—and gratitude. T. G. L.

BRIGADIER-GENERAL H. H. AUSTIN, C.B., C.M.G., D.S.O., J.P.

Brigadier-General H. H. Austin died very suddenly at his home in Southbourne on April 27 at the age of sixty-eight. Born in 1868, he was educated at Clifton College, passed direct into Woolwich, and was duly gazetted to the Royal Engineers in 1887. In 1890–91 he was employed on railway survey work on the Indian frontier and the Kabul river and Zhob valley areas. In 1891–92 he was taken by Major, afterwards Sir R. L. J. Macdonald, to East Africa, to assist in the preliminary survey for the Uganda railway. In 1894–95 he served with the Waziristan expedition. He became a Fellow of the Society in 1893. In June 1897 he was once more in Uganda, and saw active service in the mutiny of the Sudanese troops. He commanded at Lubwas, repelled the attack on Kijembo, and was at the capture of Kabagambi, afterwards commanding the post at Mruli. For this he received the D.S.O., and the 3rd class Brilliant Star of Zanzibar and medal with two clasps, and a brevet Majority.

In 1897–98 he surveyed with prismatic compass and pedometer, checked by astronomical observations, considerable portions of East Africa and Uganda, and was the first Englishman to survey the western coast-line of Lake Rudolf. He was employed under the Foreign Office in 1899–1902 in surveying in the vicinity of Lake Rudolf the frontiers of Abyssinia, the Sudan, and Uganda. In the second expedition, from November 1900 to October 1901, he was accompanied by two British officers, about 32 native porters, 4 personal servants, and an escort of 1 native officer and 20 Sudanese of the 10th Battalion of the Egyptian Army. It had been arranged by Sir John Harrington, British Minister at Addis Ababa, that a party of Abyssinians should meet Austin's party with a supply of food at the north end of Lake Rudolf. They failed to do so and Austin had to return through hostile country along the western shore of Lake Rudolf, practically starving, to a post of the Uganda Protectorate. It was only his indomitable pluck that brought his party, now sadly reduced, to the safety of the Uganda post—forty-five out of a total of fifty-nine natives had died. For this he was mentioned in despatches again and received the C.M.G.

He entered the Staff College at Camberley in 1903, as a specially selected candidate. In 1905 he was promoted Major in the Royal Engineers, and in 1906 he was awarded the Cuthbert Peek Grant by the Royal Geographical Society.

In 1907 he resumed service in India on the Staff of the Headquarters of the Army as G.S.O.2. In 1909–10 he was on special duty in the prevention of gun-running in the Persian Gulf. He was made brevet Lieutenant-Colonel in 1911. After nine months on the instructional staff of the Quetta Staff College, he went in 1914 to Simla as G.S.O.1, and six months later, in 1915, was appointed Commandant of the first Indian Cadet College at Quetta. In December 1915 he went to Mesopotamia as senior staff officer to Lieutenant-General Sir Fenton Aylmer, engaged in the relief of Kut. In 1916 he was appointed to the command of the Tigris Defences on the lines of communication. He received a brevet Colonelcy in 1917, and the 3rd class Servian White Eagle, and the C.B. in 1918. After the conclusion of hostilities he commanded the Assyrian refugee camp at Baqubah.

He married in 1912, Winifred, elder daughter of Lieutenant-Colonel W. H. McCausland, and leaves two sons and a daughter.

After his long and interesting career in the Army he retired in 1920, and associated himself with the local activities of Bournemouth, becoming a J.P. in 1932. He was a strong supporter of the Royal Empire Society, being president of the Hants and Dorset branch, and he did much good work in the town.

He was the author of several books, among them 'With Macdonald in Uganda,' 'Gun-running in the Gulf,' and 'Some rambles of a Sapper.' General Austin was a man who will be greatly missed by all who had the privilege of knowing him. R. G. T. B.

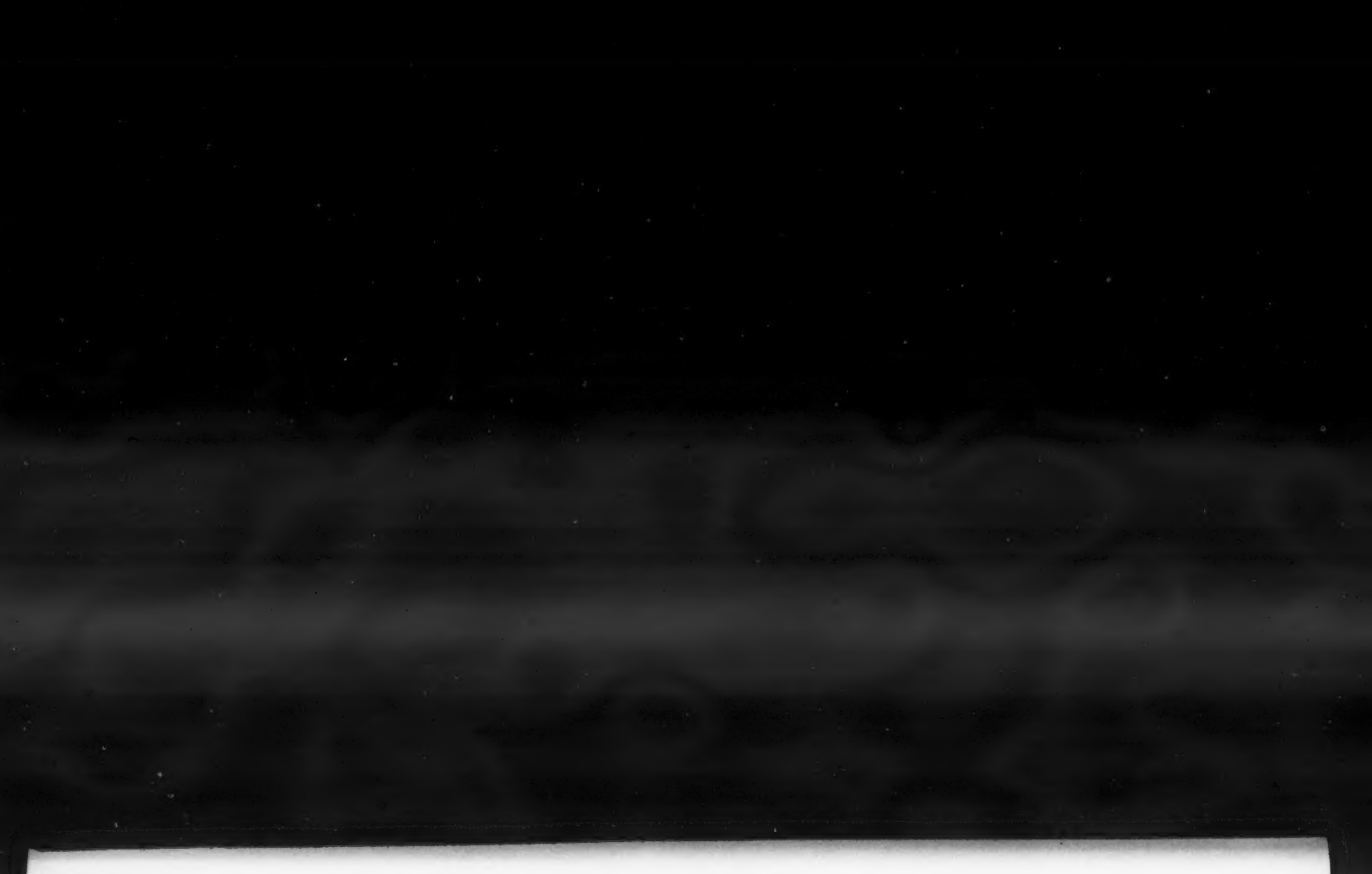
MEETINGS: SESSION 1936–37

Fourteenth Evening Meeting, 24 May 1937. The President in the Chair

Elections: Thomas Henry Catlow; Sydney Frederick Arthur Coles; Peter Sanger-Davies; Miss Alice Dodge; Mrs. Annie Hallett; Martin H. Hardcastle; Albert David Jackson, M.A., M.SC.; Hasmukh M. Khakhar, PH.D., M.R.A.S., F.R.S.A.; John Leigh; Dr. Harry Lyth; Romesh Chandra Mathur; Captain Cecil John Parker; Mrs. F. Stoker

Paper: The Kangerdlugssuak region of East Greenland. By Mr. Lawrence Wager

Fifteenth Evening Meeting, 7 June 1937. The President in the Chair

Elections: W. G. V. Balchin; John Fletcher Folliott Blandford; Wing-Commander William Alec Coryton, M.V.O., D.F.C., R.A.F.; Mrs. Sarah Dennis; Frederick Kenwood Giles; Reverend Albert I. Good, D.D.; Richard Eldred Gubbins, A.R.C.S., F.G.S.; George Fulford Hanson; Charles Hembry Hayward, M.I.MECH.E., M.I.N.A.; G. V. Hett, M.A.; W. Bramwell Hill; Lady Hirtzel; John Thorpe Holloway, M.SC.; A. N. Kapur, M.A.; Sohrab K. H. Katrak; James McEwan Macintyre; William Alexander Gibson Martin; J. L. Milverton; Sydney Moorhouse; Harry Oakes; J. F. Blake O'Sullivan; Reverend B. J. C. Pinto; Sangarapillai Rajaratnam; A. Russell Reusing; Rupert Farncombe Russell; Hasan Bey Sadek, PH.D., B.SC., F.G.S.; Charles Langford Sidey; The Rt. Reverend Bishop J. Taylor Smith, K.C.B., C.V.O., D.D.; A. F. Strange; Stanley Thomas Ternouth; Captain Warwick M. Tompkins; David Arthur Watkins, B.A.; Miss Ethel May Wrangham

Paper: A survey in West Greenland. By Mr. Peter Mott